PROCEEDINGS

Joint Meeting of the

NORTH CENTRAL WEED CONTROL CONFERENCE

(Sixteenth)

and the

WESTERN CANADIAN WEED CONTROL CONFERENCE

(Tenth)

DECEMBER 8, 9, 10, 1959

WINNIPEG, MANITOBA

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Proceedings

Joint Meeting of the

North Central Weed Control Conference

(Sixteenth)

and the

Western Canadian Weed Control Conference

(Tenth)

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NORTH CENTRAL WEED CONTROL CONFERENCE

Announcement of 1960 Meeting

Milwaukee, Wisconsin

December 12, 13, 14, 1960

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Preface

The Proceedings of the 16th Annual Meeting of the North Central Weed Control Conference and the Tenth Western Canadian Weed Control Conference presents a record of the papers and reports presented at the 1959 Conference in Winnipeg, Manitoba, December 8, 9, and 10. With the exception of the President's remarks and certain invitation papers, only abstracts of the papers given, limited to 900 words, are presented here. Since essentially all of the papers are abstracts, none have been so marked.

The Research Reports have been printed and made a part of the Proceedings. Last year, summaries of the Research Reports of the important advances in weed control from 1945 to 1958 were prepared by members of the Research Committee and published as "Research Summaries". This year, a supplement to these reports has been prepared and is published as "Summary of New Research Findings", which follows immediately after the Proceedings.

Throughout this volume all rates of application of chemicals except inorganic soil sterilants are given in terms of the acid equivalent or active ingredient, so that no statement is made in connection with rates unless for some reason the rates cited are not of the acid equivalent or active ingredient.

Latin names of weeds and crops discussed and the full chemical names of herbicides for which standard names or abbreviations have been adopted by the Weed Society of America will be found in the indexes, and such names have been omitted elsewhere in the Proceedings. Chemical names of new chemicals are given in each report of their use, and also in the index. No new products of which the chemical identity has not been released are discussed in this publication.

Copies of this Proceedings are available at $4.00 per copy from John D. Furrer, Secretary-Treasurer, North Central Weed Control Conference, Department of Agronomy, 228 Keim Hall, University of Nebraska, Lincoln, Nebraska.

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PRESIDENT'S REMARKS

J. Roe Foster

Mr. Chairman, Your Worship, Members of the North Central Weed Control Conference, the Western Canadian Weed Control Conference, the Canadian National Weed Committee, Friends and Guests:

It is a real pleasure and a privilege for me to welcome you all to the 16th Annual Meeting of the North Central Weed Control Conference. This is especially so, since we are joining with the weed workers in Canada in their own Western Canadian Weed Control Conference meeting, along with their National Weed Committee. This is the second time that these two conferences have met together in a joint meeting, the last time being here in Winnipeg in 1952.

This meeting together of these two conferences which have common objectives is an outstanding example of international cooperation in a broad frontal attack on a common and serious problem. We all know that weeds have no respect for international borders. I know that the weed workers in both the North Central States and Western Canada realize this and have been working together on their common problems for many years. They have been pooling their information and data, as is evident every year by the number of papers and abstracts by Canadian contributors which appear in the proceedings of the North Central Weed Control Conference. Let me also say that the North Central Conference is very glad to have all the results of the work being carried on in Western Canada.

To carry the international aspects of these two conferences one step further, the North Central Board of Directors saw fit last year to have a Canadian act as their President. I would like you to know that it has been an outstanding privilege and honor for me to act in this capacity during the past year and I accepted it with extreme humbleness. I look upon this assignment as a recognition of the valuable work and contributions of all the Canadian weed workers to the North Central Conference, rather than any special qualifications which I personally had to carry out the assignment as your President. I have been associated with the North Central Conference for many years and hope that I may continue to be for many years to come.

For me to bring greetings to all the weed workers in Canada may seem, under the circumstances, like bringing coal to Newcastle! However, I am sure that all members of the North Central Conference would want me to do this. They are always glad to join with the Canadians in their deliberations. I am also sure that any of the wives who came up to Winnipeg will be delighted to have a go at the shops in town. Winnipeg happens to be very well equipped to cater to the shopping whims of wives, especially at this time of year!

It has been a real pleasure to serve as your president during the past year. I have enjoyed working with the various committees and members in planning this joint conference. This type of conference naturally entails a little more planning and organizing that a single conference. Much of this planning has to be done at long range by correspondence and telephone because of the tremendous area covered by the North Central and Western Canadian conferences. However, I feel that this has been done in a very efficient and capable manner. Having served last year as your Vice-President and Chairman of your program committee, and as your President this year, I have had to have a lot of help from a lot of people. I was delighted with the response and no one ever turned down a request to act on a committee or in any other capacity when requested. I would like to thank personally all those who gave to much of their time and talents during the past year in laying the groundwork for this conference which I am sure will be a success, mainly because of your efforts. If I were ever asked to suggest another name for our North Central Conference, I feel that I could do no better than call it the "Willing Workers of America." Your committee chairmen and members, as well as your Board of Directors, are shown on your program and I want to thank them all on your behalf.

Our Conference this year required a little extra planning because of the fact that it was a joint meeting with the Western Canadian Weed Control Conference and because it was being held in Canada. A special local arrangements committee was set up here in Winnipeg to look after the great number of details necessary to successfully arrange for the meeting this year. I want, at this time, to pay special tribute and say a special "thank you" to Alex Craig and all the members of his committee for the very fine job they have done to ensure the success of our joint meeting.

At our meetings last year in Cincinnati, a new procedure was announced and introduced in connection with publications and reports coming out of the Conference. You will recall that there were no recommendations as such. In its stead, a research summary was made available at the conference. The Proceedings were printed afterwards and distributed to all those who registered at the meetings and were available for sale to anyone who wanted them.

Most of you will have seen the 1958 Proceedings by this time. I think you will have to agree with me that it is a really outstanding publication in its field and a great improvement on our previous publications. I say this without detracting in any way from the value of previous publications emanating from our past conferences. You will notice that last year's proceedings contains many things which did not appear before. It lists the names of your Officers and Directors for the current year, as well as for the ensuing year; it contains abstracts of all the papers presented at the conference, with a minimum of tables, and there is a maximum length set up for these abstracts of papers so you are getting only the "meat" of the presentation. You will also notice that abstracts of the meetings of your Board of Directors are included and I feel this is worth while in keeping conference members informed on the operation of their organization. The citation for Industry awards to the outstanding Regulatory and Extension workers in the conference area, as well as that for honorary membership, are printed. The winning essay in our essay contest is also published in these proceedings.

Last, but not least, the research summary which you received at the conference last year is repeated in printed form in the proceedings. This summary, to me, is an outstanding accumulation of research data and information. It represents a lot of hard work and digging for data by a lot of people whose names are listed at the beginning of the summaries. These summaries include all the important advances in weed control techniques developed in the North Central and Western Canadian regions for the 14-year period from 1945 to 1958, inclusive. This represents a tremendous amount of research over this period and I do not know of any place where so much information in such a concise form on such a wide range of weed problems can be found.

All weed workers everywhere appreciate the efforts of the summarizers. I am sure that they would also like me to pay a special tribute to the guiding hand behind the actual production of these proceedings in the printed form. I am referring to our Editor, Dr. C. J. Willard of Ohio State University. Only he knows the stacks of manuscripts which have had to be carefully reviewed and revised, in consultation with authors, to come up with the printed material which is available to all of you. Thank you, Dr. Willard, for an outstanding piece of work, on behalf of weed workers everywhere. Dr. Willard retired earlier this year from the Ohio State University staff, but is still carrying on as our Confer-

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ence Editor and I hope he may continue to do this for many years to come.

If you read the abstracts of your Board of Directors meeting last year, you noticed that there will be some changes coming up in the operation of your conference in the next year or two. We have had a committee set up to study the advisability of holding our meetings every second year rather than annually. Your committee voted overwhelmingly for biennial meetings and brought in a recommendation to this effect to your Board of Directors.

Our present constitution requires that the conference hold annual meetings, so a revision of our bylaws is necessary for us to undertake this change. We have had a committee set up to review the constitution during the past year and they will be bringing in the above-mentioned recommendation, along with others, for consideration of the Board of Directors.

When this proposal is finalized, our conference meetings will alternate with the meetings of the Weed Society of America. As many of you know, the Weed Society of America is meeting in Denver in February, 1960, and the Western Weed Conference will be acting as host conference. Present plans are for the Weed Society of America to meet in St. Louis, Missouri, in 1961, when our own Conference will act as host, but will not hold our Conference. We will, of course, have one in 1960, and you will be advised of the location and dates later on at this conference.

Once the Conference embarks on biennial meetings, it is not anticipated that any break will occur in accumulation of research data, due to the fact that no conference is being held on alternate years. We hope that our research committee will carry on in this field in off-conference years and will have the data available for publication when the conference is held.

You will have gathered, by looking over your program, that we are a long way from the end of the road in weed research. Many problems still confront the research man as well as the farmer on the land. You no doubt all read with concern the news release a few weeks ago to the effect that one of our well-known and valuable weed control chemicals caused cancer when injected into rats by one research worker in another field. It did not take long for the "carnage of the cranberries" to take place and the unfavorable reaction was instantaneous, violent and nation wide. I noticed where someone estimated that it would require 15,000 pounds of cranberries treated with amino triazole for weed control to provide the same quantity of the chemical as was injected into the research rats. I doubt if even Paul Bunyan could have eaten this many cranberries, and even if he could have, he would have died from the biggest stomach ache of all time!

I noticed in Time Magazine a short time ago a report about a building manager in Washington who was unable to control crabgrass on lawns around his buildings and apartment blocks. He decided to just grow crabgrass. His trouble was that it turned brown at the first frost. A chemical company came to his rescue in this problem with a product they called Luminall Lawn Tint, to spray over the brown spots and keep it green all winter!

These incidents do nothing towards solving the problems involved and this must be the constant objective of research workers. The cranberry incident points up how important it is for us to know or find out everything possible about the strange world of herbicides with which many of us are working. It is interesting to speculate as to where we would be in chemical weed control today if someone had discovered 15 years ago that 2,4-D or TCA caused rats or mice to lose their teeth or hair. We are dealing with powerful chemicals and we do not know all the answers yet. Much more basic research is required on many phases of how these chemicals carry out their functions within the plant. Research workers in general have enquiring minds. In research, we do not make much progress when we confine our efforts to the realm which we know and with which we are familiar. It is when we break through the barrier and pick something out of the unknown realm that real progress becomes apparent.

Many new tools of science are available to research workers in the agricultural chemical field. The use of radioactive tracers enables workers to follow the path of plant foods and chemicals as they move throughout the plants. This gives a better understanding of many plant reactions which were a mystery to us a few years ago. New chemicals, which control the formation of sexual gametes in plants, open up all sorts of possibilities, especially in the production of hybrid seed. This field is only in its infancy as yet.

If you will look over your program, you will notice that there are more papers and discussions on wild oats and their control than we have had before, and more than on any other specific weed. I think we will all agree that the wild oat is the most troublesome and persistent weed in the small grain growing areas of the North Central and Western Canadian regions. There are presently more research workers concentrating their efforts on finding a solution to this problem and this is indicated by the additional papers being presented this year. This is all to the good and I have every reason to believe that sooner or later some of you will find the practical answer to the control of wild oats. When you do, a great many people will be eternally grateful to you.

General weed control programs in the United States and Canada cannot be successfully carried out by any individual, or even a small group of individuals. It requires a concentrated effort by a large group, each working in the different aspects of an overall general program.

Research is essential in order to find out the facts about weeds and to learn how to control them. Once this is found out, it does absolutely no good if it is relegated to a filing cabinet or a publication in a library. The extension worker must get into the game and make the necessary information available to the farmer who is going to control the weeds. He must show the farmer why he must control weeds and let him know the best known methods of accomplishing this objective.

We have state and provincial weed laws in the United States and Canada designed to prevent the spread of noxious weeds and protect the farmer and the general public against encroachment by weeds with resulting losses and hardships. In this field, the regulatory worker and weed inspectors are important members of the team and render a substantial contribution to any weed control program.

It requires equipment, power and chemicals to carry out a successful program to its ultimate conclusion. In this field, our industrial groups have made, and are still making, an invaluable contribution. Many of these groups have excellent research programs which have done much to augment the research being carried out by Government and University authorities. Industry must make the necessary equipment and chemicals available to the farmer where and when he wants it, and at a price he can afford to pay. I would like to commend the Industrial groups in both the United States and Canada for the very fine job they are doing in carrying out their part in the over-all weed control programs.

One more factor enters into the ultimate success of this program. We have research workers, extension workers, regulatory workers and workers in industry, all concentrating on weed control. This represents a large team of workers; and to be successful, their efforts must be co-ordinated. This is where the Weed Control Conferences come into the picture. It brings the workers in all these disciplines together where they can discuss

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past accomplishments and plan future work. These conferences enable a co-ordinated team effort to be organized and much more pressure brought to bear on our mutual problems. I feel that both the North Central and Western Canadian Weed Control Conferences have made a very valuable contribution to the promotion of successful weed control programs and I am confident that they will continue to do so for many years to come.

In closing, let me express the hope that you will all find our present deliberations enlightening and enjoyable.

Let me say again how much I have enjoyed my year as your President and hope that we may all meet again before too long in a joint conference such as we are having here this week.

SELLING WEED CONTROL TO THE FARMER

E. P. Sylwester

Mr. Chairman, members of the joint conference, ladies and gentlemen:

Your chairman, Dr. Friesen, has accorded me a distinct honor in asking me to appear before the opening session of this Joint North Central and Western Canadian Weed Control Conference. I can assure you that this honor is greatly appreciated. I only hope that my remarks this morning will impart something of value which can be used by all of you as you deal with weed control problems in your home areas.

The function of the Extension Service is to take the findings of research and demonstrations, interpret them and make them useful in the pursuit of agriculture. The mandate of carrying the "products of research" so that the man on the "back forty" can make use of these discoveries is the life blood of the Extension Service. We must put the technical products of research into a language understandable by our clients. We must remember, that in carrying this information to the farmer, that we are dealing with the most stable and most conservative sections of our society. This has always been the case. For that reason we can perhaps expect slower progress in our programs. By application and hard work, sometimes by trial and error, farmers have been uniquely successful. They are highly mechanized. They are past masters in the use of machinery. This they understand, whereas chemical weed control is a completely new, strange field.

The extension service program differs markedly from resident teaching programs. In the extension service educational program there are no required courses; you are dealing with adults, mature men and women. There are no uniform meeting places. There are no regularly consistent, scheduled meetings. There are no assignments for future meetings, no examinations and no report cards. In scheduling extension meetings we have to compete with their work, radio, television, newspapers, farm magazines and a host of other obligations and factors. While this ever-present competition undoubtedly cuts into extension service meeting attendance, when we consider the nature of this competition we must honestly admit that attendance at our meetings has held up extremely well and that we are slowly getting the story of modern weed control across to the general public. And we must remember, too, that the Extension Service has at its disposal innumerable avenues of education such as radio, television, newspapers and farm magazines. Thus, while it may appear that attendance at regular scheduled meetings may occasionally be dropping, we must remember that maybe we are contacting many of these same people in other avenues such as I have just mentioned.

As I look at extension weed control work in the future, there will undoubtedly be more emphasis placed on fewer and larger meetings, on better beforehand planning, on better mass media educational methods. But scheduled meetings where the latest findings of research are interpreted to the farmers and where questions can be asked, will continue to be one of the main avenues of educational work in the extension service in the future. Such meetings will never be completely replaced.

We should never be discouraged if our listeners or readers do not take our advice hook, line, and sinker after the first exposure. Remember we are dealing with a conservative and stable section of society. Many of them are slow to abandon tried and true methods of weed control in favor of something new and unknown. Actually we encourage a gradual transition. I believe that most of us have experienced and seen a slow steady growth in the use of chemicals. In all of our weed control work we always use cultural weed control as the anchor, the known portion of the job, and then expand from there into how this task can be aided and abetted with modern weed-killing chemicals. While the growth in the use of weed-killing chemicals has been slow in many instances, remember that in the long run it is a slow, healthy, ever-increasing growth, and this is as it should be.

In the carrying out of extension education there are many cardinal principles to be kept in mind. Among these are the following:

1. **Believe in yourself. Remember that you are selling education.** Remember that you have the fact of weed losses on your side. There isn't a farmer that experienced laborious work, decreased crop yields, lost crops, dockage in his products, livestock and human poisoning, and depreciation of land values because of the weed problem. Research invariably shows the tremendous losses suffered by American farmers because of the weed problem. Whether you are selling brushes, magazines, automobiles, or education, remember that you have a high calling and that your job is the most important one in the world. You are trying to help people, make life easier and more profitable for them. In addition to believing in yourself, you'd better be a good example and practice what you preach. Let it never be said about extension workers in weed control, "do as I say, not as I do" or "everyone has shoes except the cobbler's children." Practice good stewardship of the land as an example of what can be done. I suppose it does happen but very seldom do you see a Ford salesman driving a Chevrolet or vice versa.

2. **Carry the program to them. This is the function and the mandate of the Extension Service.** Remember that it is often easier for one man, namely you, to go to an out-of-the-way meeting place rather than have 25 to 50 people come a considerable distance to a meeting in strange surroundings. Once in a while there are racial barriers, social barriers, geographical limitations, etc., which must be considered. People like to associate and will attend meetings with other people that they know. Sometimes these meeting places are only 15 to 25 miles apart, but very often it would be unwise to schedule one county meeting to replace two or three district meetings in the county where groups would be more congenial.

3. **Not all groups learn equally fast.** Remember that in the same meeting there are people with a college education and people who perhaps have never been privileged to be able to attend school much past the eighth grade. The fact that most farmers have been inherently successful is a tribute to their hard work and ingenuity. Very often as you shake their calloused hands you have the feeling that everything they have has come the hard way. This discrepancy in education is a challenge to the extension specialist who presents material to such a group. He must assume a median position keeping the interest of the people who are quite highly educated and at the same time not talk over the

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heads of the remainder of the people. We should be patient, talk to them, not at them, and remember that every single problem may have to be handled just a little differently because of financial situation, machinery, general stewardship, etc. In every group there are the "early adopters," the "eager beavers," the "late adopters" and the "never adopters." Remember, too, that the "late adopters" may in turn be convinced on the local level by the "early adopters" of the weed control practices. These "early adopters" are really "volunteer leaders" that the Extension Service can build up and rely upon to help spread information on cultural and chemical weed control.

4. **Combination of topics.** There is a long over-due but growing tendency to treat farming as a "package" proposition. We are finding more and more response for instance to Joint Pest Control Meetings, especially in the field of entomology and to some extent plant pathology. Many of the methods and procedures, the equipment used in application, the dealers selling pesticides, the problems of safety in application, and methods of application are all very similar. At some of these combined meetings we try to present only the most recent work which has a bearing on the immediate future work. We have noticed a growing tendency toward a two- or three-day session embracing general "efficiency" in agriculture, not only in weed control, insect control, but also in the realm of soil conservation, soil fertility, wildlife management, etc. Such meetings are a conservation of time from the standpoint of the specialist and keeping the general populace informed as to the latest developments in several fields. This conserves their time too.

5. **Timeliness.** Our most successful meetings are held after the first of the year during the months of January, February and March. Anything you do prior to January 1 belongs to the season just past, and who is interested in old information. But after the first of the year, we are headed into a new cropping season. This presents a problem of scheduling. In the future we must pay more attention to plan better meetings and make them more timely. But the tempo of any meeting is always much enhanced after the first of the year. This is especially true this year when we have experienced difficulties in harvesting our state's major crop, namely corn. So any meeting prior to the first of the year belongs to the season just past, with its hardships, trials and tribulations. The farmer, after the first of the year, always looks to spring with optimism and is in a much more receptive mood to embrace those things pertaining to efficient agriculture. The things that are of greatest importance so far as the individual region is concerned, are the things which deserve the greatest emphasis. After all, there is not much need of talking about the control of weeds in flax and sugar beets in an area where pasture weed and brush control are of prime importance.

6. **Time of meetings.** If there is ever such a time as a "slack time" on a farm it is perhaps during the months of January, February and March. We have had equally good results scheduling a meeting either in the afternoon or in the evening in those months. The attendance at such meetings is in direct proportion to the problem at hand and to the work which the local county extension director expends in publicizing and inviting people to the meeting. Very often this takes personal invitation and wherever a good county agent has put his heart into scheduling a good meeting and has gone out of his way to publicize and interest people in it, the results have been very encouraging. Furthermore, recommendations that are made at such meetings at the beginning of the current cropping season, the farmer is able to think about them and take such steps as necessary to put such information into active use in the spring. Personally, I don't think that mass media such as radio, television, newspapers or farm magazines will ever completely replace the human element possible in neighborhood and county meetings of this kind. As I have mentioned before, attendance at our meetings has held up remarkably well.

7. **Single topic meetings.** I have mentioned some tendency toward pest control meetings and institutes where several topics are covered at one time. The County Extension Councils in planning their program, very often feel that weed control, insect control and soil fertility are important enough topics that one whole afternoon or evening should be spent discussing their many ramifications. Consequently we have many meetings where weed control is the only topic. These meetings, too, are very well-attended and we have noticed no major decline in popularity with other competition. It gives the specialist a little more time to present the picture clearly, to hit the high spots and to make the entire weed control story a little more complete. The main thing to guard against at any meeting, joint or single so far as topic is concerned, is to remember that other people's time is important, too. They have other jobs to do, other appointments and commitments, etc., chores to do at home. The extension specialist must always remember that "the mind can absorb only what the seat can endure."

8. **Added incentives for attendance.** At many of our meetings where joint topics or where single topics are discussed, many of the local merchants, especially those in the custom spraying business, dealers in insecticides, fungicides, and herbicides, or dealers in equipment, contribute to the interest of the meeting by offering a few door prizes or possibly coffee and doughnuts at the conclusion of the meeting. In some instances a free noon luncheon is served with the compliments of the local Chamber of Commerce, banks or service clubs. Years ago an extension specialist of repute told me that there are two ways to get attendance at meetings. One is to give them a chance to vote "No" and the other is to feed them. One of the most delightful turn of events in the time that I have been associated with the extension service has been the period of relaxation and good fellowship afforded by a token cup of coffee and a doughnut. There is something about a cup of coffee and a doughnut at the conclusion of a meeting that seems to stimulate attendance. Prizes at field meetings, even a cigar or candy bar, draw interest.

9. **Be realistic.** Farmers as a group are reticent to talk. They may not say much but this doesn't mean that they are not interested or that they don't care or are not thinking. Many of them perhaps do more thinking about their problems, their methods of procedure than we do. Most of them have had first-hand experience in coming to grips with the problems of weed control. Remember he may be there to find out what you know about the subject that he doesn't know. Remember however, the fact that he has been fairly successful in his endeavor, means that he already knows some of the practical aspects of weed control. So don't try to bluff him. Know your subject. What he lacks in technical knowledge of the subject may be more than compensated for by experience. Remember experience is a harsh teacher but a good one. Remember it isn't so much what you don't know about a subject that gets you into trouble, it's what you know that isn't true that causes the real difficuly. When a farmer has a specific question on chemical or cultural weed control, imagine yourself in his position with his financial resources and time allocations, and then try to work out for him the best solution for him under his own particular circumstances. The Indians used to say "wear his moccasins for a day." The crops that he can utilize, the methods that he can use, the life history of the weed, the size of the infestation and its location all have a bearing on the choice of the methods that he should employ.

10. **Use all avenues and opportunities.** We try to carry on a well-rounded extension program. Our meet-

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ings continue to be the main avenues of information dissemination. We have county project meetings on weed control, supervisory board meetings where we plan better weed control methods for the counties, we set out demonstrations in conjunction with county extension directors and weed commissioners, we give help to individual counties on specific problems, we carry on dealer education meetings and we lose no opportunity to contact the general lay public by means of radio, television, newspapers and farm magazines, as requested, or when worthwhile subjects demand attention. In our demonstration work, which is extremely important, we try to get some experimental data, but we always put out the demonstration for the sake of the demonstrations and not for the sake of the experiment. In many instances these demonstrations cannot be adequately replicated to make them really meaningful so far as experiments are concerned. But we have not much to do to demonstrate the already known and proven worthwhile practices of weed control that we have to leave more demonstrations undone than what we can actually do. Weed control is a popular subject. There isn't anyone who isn't affected by weed control, directly or indirectly regardless of where he lives, works, or spends his vacation. An extension specialist is a public servant and as just such should lose no opportunity to talk weed control whenever the opportunity presents itself. This may be after church, at parent-teacher organizations, or on the street. If a person is interested enough in weed control to bring up the subject to you at some time opportune to him, you owe it to him to fulfill his needs. After all, other people are busy too, and no good salesman ever loses an opportunity to talk business as occasion demands. By this I don't mean that we should become slaves to our profession. Always remember this poem:

"If you keep your nose on the grindstone rough,
And keep it down there long enough,
You'll soon forget that there's such a thing
As brooks that babble and birds that sing.
Just these three things will your world compose:
Yourself, the stone, and your darn old nose!"

11. **Keep it brief and simple.** Remember other people are busy too. At meetings don't make people wait for you. Be on time. They have obligations, work, appointments, etc., too. Remember you cannot possibly educate them to the fullest degree in all facets of weed control in one meeting. Don't unload the whole load, but hit the important points, the things that are of immediate benefit to them. Remember that the greatest story can be told in the simplest words. Keep the recommendations and procedures simple. Remember the story which carries an extension moral. "Once upon a time a man recommended a particular salt for a certain ailment. Of those suffering from this ailment who heard of the cure, 90 percent used it and were satisfied with the results. The man then suggested that the salt be dissolved in water before taking, whereupon only 75 percent of the people used it. Then he advised that the remedy be prepared in the proportion of 4½ ounces of the salt to 8⅓ quarts of water. He found that only 60 percent of the people took it. He next warned against using anything but chinaware receptacles for containing the remedy and only 45 percent used it. Then he advised that the water first be boiled and the percentage of customers dropped to 30 percent. The next step was to recommend that the solution be strained through muslin cloth and only 15 percent bought it. Distilled water exclusively was then advised for use in preparing the solution and nobody at all used it. Each modification had been sound and wise and the man was much disappointed. In desperation he finally made up the remedy ready for use in his own laboratory and gave it a distinctive name and everybody used it and he was happy." The moral of the story was that everything else being equal the number of persons who will adopt the recommendation varies inversely with the number of points of complexity in the recommendation itself. So our weed control recommendations must be simple and easy to understand if they are to be adopted.

In conclusion, ladies and gentlemen, it has been a distinct honor and privilege for me to address this group. Thank you very much.

CONTROL OF WOODY PLANTS IN PASTURES AND RANGELAND

M. Aaston[1]

During the past few years, interest has increased in the control of herbaceous and woody plants in pastures and rangelands in Western Canada. The increased interest in pasture improvement has been stimulated by the effective use of new herbicides and improved techniques in land clearing, cultivation, and regrassing operations. Increased grassland farming, along with a demand for more economical livestock production and the realization that early methods of coping with brush were too clostly, has created greater attention to making new developments for brush and weed control on grazing lands.

This paper will deal with the various methods that have been attempted and developed, along with cost figures for the control of undesirable woody plants on pastures and rangelands in the Parkland Area of the Western Canadian provinces.

Description of Area

The Parkland Area can be described as the transition area from the open plains to the true northern forest. The soil consists of black to degraded black soils generally developed on glacial till and lacustrine deposits. The temperature varies from an extreme low of —60°F to an extreme high of 100°F. The average summer temperature from April to October is approximately 52°F. The average yearly precipitation ranges from 14 inches in Northwestern Saskatchewan to 20 inches in the southern and western portions of the Interlake Region of Manitoba. The average summer evaporation from April to October varies from 27 inches in Northwestern Saskatchewan to 21 inches in the same area of the Interlake Region of Manitoba. The main woody species found in this area consist of balsam poplar, aspen poplar, western snowberry or buckbrush, and willows. Poplar growth, which is most prominent, reproduces quickly and easily by means of root suckers; therefore, in order to provide sustained benefits from cleared areas, special control measures are required to prevent reinfestation.

Methods of Control

Mechanical methods — In dense stands of growth greater than 2½ inches in stem diameter, various methods can be used, depending on the nature of the result required. Where a complete land clearing and cultivation operation is required to be done immediately, conventional equipment such as the twelve to sixteen-foot V-shaped cutters and piling equipment is used. The growth is cut and piled into windrows spaced at 150 feet at an average present-day cost of $24 per acre. Bulldozers for breaking the growth down and piling are also used where the removal of roots is desired for grain or forage production. Cultivation is generally done by heavy serrated disc or individually mouned disc implements. The complete clearing, cultivation, and regrassing operation is done at approximately $42 per acre. Clearing by this method, which includes piling, with dozer equipment in the winter months can be done at the same cost, providing the snow depth is not greater

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than 15 inches. Winter clearing is preferred to the previous operation if root removal is not necessary as the soil is not disturbed if the frost has penetrated the ground sufficiently. In large-scale ranching operations, this method, owing to the high cost, is limited to developing hayfields, corral and building sites.

When a complete clearing operation is not required immediately, a combination of various other methods can be used at a tremendous reduction in cost. A combination of breaking down growth by various methods, followed by spraying or burning or a combination of both, can be done. One method of breaking down the growth is by the use of sixteen-foot V-shaped cutters. The material should be left on the ground for a period of two years before burning for the best results. This also allows sufficient time to establish a good grass cover to assist in the burning operation. Areas treated by this method, which costs approximately $8 per acre, can be almost completely cleared by successful burns. The removal of the shade created by tree growth generally results in heavy native grass growth. In some cases spraying is necessary to prevent heavy regrowth of trees before sufficient grass growth can be established for a successful burn. The cut growth is partially windrowed by the wide cutters; therefore, this method has the advantage in heavy tree growth of providing immediate access to the areas for livestock grazing.

Another method which can be used is knocking down growth by bulldozer equipment after freeze-up, followed by herbicidal spraying by aircraft in one year if dense regrowth appears, and in turn followed by burning in two years. This operation generally leaves the area in a state which makes grazing difficult; therefore, a heavy carryover of grass may be expected which would provide fuel for a good fire in the first burning operation. The average cost for only knocking down growth by dozer equipment in winter is $6 per acre providing the snow depth is not greater than 20 inches. A definite disadvantage of this method is the removal of the treated areas from grazing for a period of two years until after burning. Therefore, the merits of this operation depend entirely upon the results obtained in burning. In any event, one burn at least reduces the cost of windrowing if this is desired for cultivation purposes.

The most economical method of knocking down heavy brush to facilitate spraying and burning operations in large-scale operations is the use of a cable, ship's anchor chain, or ball and chain equipment. One device which has been in use consists of 300 feet of cable weighted down in the center by track rails or other heavy weights. One variation of this which is being used extensively is 200 feet of 2-inch or 2⅜-inch steel link ship's anchor chain instead of cables. The equipment is pulled by two 80 h.p track-type tractors spaced approximately 40 feet apart. The trees are knocked down and windrowed in such a way livestock can easily graze the treated areas. Another variation is the use of a steel ball connected by 2 hundred-foot lengths of anchor chain. The recommended size of ball is one which is six feet in diameter and weighs approximately six tons. The advantage in using a ball rather than other weights is the added leverage gained by keeping the device a certain distance above the ground. The concentrated weight made by the ball also prevents any danger of the device climbing over heavy stands of growth. The ball also helps to pack the reasonably well formed windrows. The use of chains is preferable to the use of steel cables as cables tend to fray from rubbing on the trees, making cable breakages common. Fraying of cables or chain breakages can be reduced to some extent by the use of swivel connections, which prevent the twisting action on the device which ordinarily occurs. Chaining will give livestock immediate access into heavily wooded areas. It is important, however, to do the chaining on a field in two directions only, otherwise roundup operations are difficult. The best time for ball and chain clearing is in the winter months after the frost has penetrated the ground to a sufficient depth to prevent uprooting of trees. Good burns have been made with this operation after a waiting period of 2 years. The average cost of the operation has been found to be approximately $3 per acre in large-scale operations.

The use of rotary brushcutters in a small-scale operation is another method which is practical in light stands of growth. Rotary cutters five feet in width require three to four plow tractors for growth up to 2½ inches in stem diameter. There are four types of rotary cutters on the present-day market; a power take-off three-point hitch mounted type; a power take-off pull type; a power take-off front-mounted type; and a motor driven pull type. The front-mounted type performs more satisfactorily on reasonably level ground; however, it cannot be used where hummocky conditions exist. Rotary cutting can be successfully followed by burning, which almost completely destroys the sticks and twigs left from the operation.

Another land clearing operation is knocking down and breaking of growth by heavy serrated disc implements. Growth which can be cut by rotary cutters can also be destroyed by heavy discs at approximately the same cost of $5 to $7 per acre. Low-lying areas of heavy willow growth which are cleared in this way generally produce heavy stands of native grass. The ground, however, is left in a very rough condition.

Controlled burning — Controlled burning on large areas for land clearing purposes can be done successfully on standing growth in certain areas of the Parkland where heavy undergrowth of grass and shrubs exist. Fireguards, which are necessary, are generally made by conventional equipment or a combination of dozer and chain equipment from 100 to 150 feet in width in heavily wooded areas. Fireguards in areas of lighter growth can be made by heavy serrated or individually mounted disc implements. By making two black strips spaced at 100 feet, and burning the area between the two strips, a wide fireguard can be cheaply made. A good increase in palatable grasses and shrubs, particularly peavine, can be expected from burning in most areas. Fireguards, in addition to making controlled burning possible, also provide access routes for livestock into naturally open areas which they could not otherwise reach owing to the surrounding heavy brush. A system of fireguards is also a great help to general pasture operations and management in heavily wooded areas as the cattle can be more easily located and controlled, particularly in time of roundup. Controlled burning is generally most successful in the early spring, and for the best results should not be attempted until the air temperature is 80° to 90°, the relative humidity is less than 25%, and the wind velocity is from 30 to 35 miles per hour. This also applies to areas with the growth knocked down to facilitate burning by the various methods as outlined.

Herbicidal spraying—Herbicidal spraying must complement all the operations which have been outlined, including complete land clearing and regrassing. Spraying should be done when regrowth appears, which is generally a year after the operation at the latest. Application of the herbicides by aircraft is necessary on areas which have had the growth knocked down by dozers or V-shaped cutters. Areas which are entirely cleared or windrowed by the chain method can be sprayed by ground equipment such as jet or turbine sprayers.

Various herbicides—2,4-D, 2,4,5-T, and combinations of both—have been used; however, the standard butyl ester of 2,4-D is the most acceptable chemical, from the standpoint of cost and effect, for the control of woody growth in the Parkland Area. The following mixture per acre, on regrowth, is effective: 1½ pounds butyl ester

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of 2,4-D; 2 gallons of water; 1 gallon of fuel oil. This is the mixture used in aircraft or in spraying equipment which cannot apply heavier rates per acre. Only water is used where at least six gallons per acre can be applied. An excellent coverage can be obtained by turbine sprayers using a spray application of eight gallons per acre and an effective spray width of 40 feet. When a heavy application is used, good results are obtained throughout the period from June to September.

Herbicides can be effectively used on regrowth up to 20 feet in height on areas burned over by wild fires. Two spray applications are necessary in a period of two or three years for a good kill on this size of growth. More effective results are obtained, however, if the first operation consists of knocking the growth down, followed by spraying for the second operation in one or two years. One spray application on regrowth up to two feet in height is generally sufficient for at least five years.

For light applications of a spray mix by aircraft, best results are obtained under the following conditions: air temperature from 70 to 80°; high relative humidity; soil moisture conditions high for the best growing conditions; and the rate of tree growth at its maximum, which is at the time the trees come out in full leaf. Dry weather conditions will considerably reduce the effectiveness of light applications of a spray mixture.

One spray application as outlined, applied by aircraft or ground equipment, costs from $2 to $3 per acre, depending on the acreage covered.

Cultivation—After a complete land clearing operation by various methods, cultivation may be difficult, particularly where stumps, roots, logs, or rocks are left in the field. Double discing by the use of heavy serrated disc implements, followed by heavy offset discs, are sufficient in most cases. The use of individually mounted disc plows and disc harrows, however, is preferable to the above, particularly in areas with rocks and scattered logs. Implements with individually mounted discs are the type developed and used in Australia to cope with conditions there which are comparable to working conditions for cultivation of large areas of the Parkland Region of the western provinces.

Summary

Land clearing with special equipment and on a long-term basis can be done for very little cost as compared to conventional equipment for an immediate land clearing operation.

The following are recommended land clearing methods for large-scale operations on rangeland:

1. The use of chain, or ball and chain equipment on heavy stands of growth, followed by spraying and burning.
2. A combination of spraying and burning on growth up to 20 feet in height.
3. Use of rotary brush cutters or heavy serrated disc implements on growth up to 2½ inches in stem diamter, followed by burning and spraying.
4. Fireguarding for controlled burning of large areas of standing growth by dozer and chain equipment during winter conditions, followed by spraying.
5. For immediate farming or regrassing purposes, where complete land clearing is necessary, the chaining method in winter, followed by dozer equipment for windrowing, is recommended. Windrowing by dozer equipment makes well compacted windrows which can be almost completely burned without a waiting period. Cultivation is recommended to be done by individually mounted disc implements.

The control of brush in pastures and rangeland will increase and maintain a high carrying capacity in most areas of the Parkland in Western Canada. Other benefits derived from the control of brush include the increased ease of handling livestock, lower numbers of missing animals and death losses by disease and predators, and the opportunity to use more efficient pasture management practices.

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THE CONTROL OF WILD OATS

H. W. Leggett[1]

A great deal has been said and much has been written on the control of wild oats and yet the fact remains that each year the wild oat extracts a heavier toll from crops yields than any other weed. That is the statement I made at the 2nd Western Canadian Weed Control Conference held here 11 years ago when I gave a paper entitled "Whither the Wild Oat". I hope that you will agree with me, when I have finished this paper that perhaps we are now on the threshold of an era in which satisfactory control of wild oats is a reality. If this is so, the credit it due to the concerted efforts of weed researchers in Universities, Government, and Industry.

According to early literature and popular belief *Avena fatua* (wild oats) is considered to be the wild species which has given rise to our cultivated oat *(Avena sativa)*. However, Coffman is of the opinion that *Avena sterilis* is the progenitor of all the hexaploid oat species including *Avena fatua*. Griffiths and Johnston suggest that this could well be true, as their work on induced mutations showed that *Avena fatua* may have arisen as a result of mutation in *Avena sterilis*. This is not in conflict with geographical evidence as most authors agree that Asia Minor is the center of origin of oats, where *Avena fatua* and *Avena sterilis* are both found.

Wild oats rate as the most troublesome weed in a very compact block comprising the north half of South Dakota, the northwest fringe of Minnesota, much of North Dakota, Montana and most of the cultivated area in the three prairie Provinces of Canada. Within this large block there are an estimated 106 million cultivated acres of which 61 million are more or less infested with wild oats. Of this total approximately one-half, or 30 million acres, can be rated as severely infested and thus present a serious weed problem.

The reduction in yields of various crops directly attributable to wild oats is also staggering. Experiments conducted by the late T. K. Pavlychenko have revealed that even a medium infestation (20-40 wild oat plants per square yard) reduced yields of barley, our best competitive crop, by 16 percent, wheat by 33 percent, oats by 49 percent, and flax, which provides little or no competition, by 84 percent.

The chief difficulty in eradicating wild oats is the persistence of the seeds in the soil. Several important factors have a bearing on the problem. Since one wild oat plant may produce 250 seeds even a light infestation can assume serious proportions very quickly. While it has been claimed that about 95 percent of these weeds may be destroyed in one way or another, before bearing seed, we are still left from only one plant 12 seeds per square yard, which can readily become the source of a severe infestation. Unlike cultivated forms wild oat seeds shatter easily, because of the mode of articulation, which is by means of a well developed and readily separated sucker mouth and callus pad. Environmental factors such as temperature, oxygen, and moisture have been shown by Atwood, Johnson, Chepil, and Bibbey, to affect germination. Hay and Cummings, Naylor, and Black have shown that light is an important consideration. Dormancy of the seeds is probably the main factor accounting for the continued prevalence of this weed. This is a very complex problem which involves several

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of the points mentioned above. Naylor and associates at the University of Saskatchewan working on a highly dormant strain of wild oats have shown the presence of an inhibitory substance in the hull and seed coat. Naylor also postulates that the capacity for germination is determined by the opposing effects of inhibitory and promotive substances. Banting at Regina has been following the dormancy pattern of wild oat seeds under a wide range of conditions. While I have mentioned only a few of the basic studies that are being carried out it can be seen that this phase of the work is extremely important.

Cultural methods of controlling wild oats are helpful. Delayed seeding, using an early maturing barley crop, is the best method. Supplementary measures, such as fall tillage, light early-spring cultivation, post-seeding cultivation, and fertilization wll ncrease the percentage of control. Fall tllage is generally beneficial if it is done two or three weeks after harvesting. Light early-spring cultivation helps to promote earlier germination. Post-seeding cultivation, preferably with a rod weeder, and under conditions suited to its use, gives the crop a chance to get ahead of the wild oats. Fertilizers, unless used with some other methods, are not of value, but used in the overall program they give the crop an advantage over the weeds. There is, however, one important limiting factor in any one year. Climatic conditions determine the success or failure of cultural control measures. For example, when the weather is cool and moist, fall tillage usually gives poor results. On the other hand, when weather conditions in the spring permit rapid germination of wild oats, delayed seeding gives excellent control. However, should cool, moist weather prevail throughout the growing season, delayed seeding may not be satisfactory.

Fall-seeded crops have proved advantageous where it is possible to use them. Since only a relatively small acreage in Western Canada is a good fall crop risk, this method has only limited usefulness. Rotations that include grass or a grass and legume mixture have, under some conditions, given adequate control. However, unless carried on for a great many years such rotations have not been an outstanding success. Seeding down to grass for varying periods of time, on heavily infested areas, has in only a very few cases given good control. Usually sod tends to preserve wild oat seeds up to 10 years. The use of intertilled crops is not practical on the Prairies even though with thorough cultivation excellent results are obtainable over a relatively few years. Green feed crops that are cut before the wild oats come into head are practical and efficient as a control measure but this method has only limited application.

Since the advent of 2,4-D chemical control of wild oats has captured the imagination of all those interested in this particular weed problem. That it would be a difficult task was understood but this did not seem to matter. Thousands of chemicals were screened for the sole purpose of finding a lead that would eventually point the way to some effective method of control. These studies eventually branched into three main avenues. Pre-emergence treatments were explored hoping for a chemical that would be selective enough to kill the wild oats as they emerged without damaging the crop. It could be said that this was partially successful because we did find chemicals that would do this job. But the unfortunate part was that the crops concerned were not our common cereals. The second approach was to look for a chemical that could be sprayed on the wild oats in the standing crop which would not damage the crop but at the same time would damage or otherwise impair the developing wild oat seed. At one time we felt that we were close to something tangible in this regard. Post-emergence treatment with maleic hydrazide at the at the early milk stage effectively reduced the number of viable wild oat seeds. At the same time crop damage in barley was minimized if the plants had advanced beyond the milk stage. Unfortunately the critical timing necessary for successful results just never materialized under natural field conditions. We must, however, point out that maleic hydrazide did help to maintain interest in this type of approach. At the present time we have a post-emergence chemical which is highly selective in barley and reasonably so in wheat. This chemical gives consistently good control if environmental conditions are favourable and if application is made at the correct stage of growth of the wild oat. This can be described as a major accomplishment and emphasizes the great strides that have been made in chemical control of our number one weed.

By far the largest number of chemicals have been screened in what is called pre-planting treatments. This third approach is aimed at three possible methods of attack. (1)To selectively control wild oat seedlings in cereal crops or flax. (2) destroy the germinability of the wild oats seeds in the soil and not persist long enough to harm the later seeded crop. (3) To break the dormancy of the wild oat by means of a chemical thus permitting germination and subsequent destruction by cultivation. The latter two methods are aimed at eradication of the wild oat seeds in the soil. While we know of chemicals that will destroy the germinability of some seeds in the soil they are by no means practical when one is talking about anything but extremely small patches. As far as coming up with a chemical that will break dormancy there has been limited progress and as I have pointed out earlier Naylor's work does suggest the possible presence of promotive substances. True there have been isolated reports on the effect of nitrogen applications for this purpose but nothing of a concrete nature has ever come to the fore. This brings us to point number one which is to find a chemical that can be sprayed on the soil, incorporated into the top 3 or 4 inches, prior to or at the same time as seeding a selective crop. There have been quite a few chemicals that have shown considerable progress along this line but unfortunately the crops that were tolerant were not our common cereals. However, because of the persistence of certain individuals in their search for this type of treatment we now have a chemcal that will give us an excellent measure of wild oat control and one which is completely tolerant to flax and only slightly less tolerant to barley and wheat. Once again we can say that this is a major accomplishment and one that should have a very practical significance in the Northern Great Plains area where small grain production predominates.

I have pointed out that for the first time, after years of work on the part of the chemical industry and the research workers, we have finally achieved the first plateau in our struggle to control wild oats. There are bound to be new accomplishments and refinements, and even new methods. This isn't the end—but rather the beginning.

In speculating on the potential use of a chemical which will successfully control wild oats we must be realistic. The vast area in need of effective control may be analyzed in terms of practical cost to the farmer. We can say that the area seeded to wheat, barley and flax in the three prairie provinces that is infested to some degree with wild oats each year is in the neighborhood of 28,000,000 acres. We can also say that 45 percent of this area, or approximately 12,000,000 acres is heavily infested. Just what does this mean in terms of what I shall call "saleable potential." This leaves us with a figure of 12,000,000 acres that could be profitably treated at a price. Taking a look at the acreage sprayed with 2,4-D and its price structure over the years, as well as a look at the response to fertilizer, it is possible to deduce that a chemical that showed very real reductions in wild oats should have a 10,000,000 acre potential, over a 3 year period, at a cost of approximately $1.00 an acre. At $2.00 per acre the potential area should be in the neighborhood of 6,000,000 acres. At each one dollar rise above this figure, it seems to me that the potential acreage would fall by perhaps fifty percent up to a $5.00

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limit. This would mean that at $5.00 per acre for chemical the potential would be 750,000 acres. One must remember that there are many points to consider when coming up with an analysis such as the above. However, in formulating this set of figures and discussing it with farmers I feel that they should be a help, particularly, to those of you in the chemical industry.

In conclusion I can't help but feel optimistic with the fact that finally we are seeing two chemicals introduced which have very definite promise in providing farmers, plagued with wild oats, some relief. I think I can say with confidence that this is a very promising start.

[1] Regina Experimental Farm

PERENNIAL WEEDS, CULTURAL AND CHEMICAL CONTROL

G. W. Selleck[1]

Cultural Control

It is important in the control of perennial weeds on summerfallow that the first tillage operation commence in the fall immediately after the removal of the crop. The neglect of this aspect of control may partially account for the recent increase in dandelion, sow thistle and Canada thistle on cultivated land. Toadflax populations in Saskatchewan have been thinned out by utilization of this method in an alternate summerfallowing and cropping rotation so that occasionally two consecutive crops can be grown. The beetle *Brachypterolus pulicarius* has probably contributed to the reduction of vigor displayed by this plant in Saskatchewan. Bladder campion is considered to be a persistent perennial in Saskatchewan and is widespread in the Cudworth district. Survey data that I obtained in that area this summer indicated that the weed could be killed with intensive summerfallow in one year.

Cultivation is the only feasible means of controlling field infestations of couchgrass in Western Canada. However, where soil erosion is a problem, the herbicides TCA or dalapon may be used in conjunction with tillage.

Chemical Control

The soil sterilants monuron and sodium chlorate are most effective for the control of couchgrass in noncultivated land. Where control is required on noncultivated land and where soil sterilization is not desired, the herbicides TCA and dalapon may be effective. About 100 lb/A of TCA or 80 lb/A of dalapon are required for complete eradication with one application. These herbicides at light rates are effective also in the control of grasses in shelter belts and fruit trees. Repeated applications may be used, but both herbicides are more effective in conjunction with tillage. Other herbicides which show promise for couchgrass control are amitrol, 2,3,6-trichlorophenylacetic acid (Fenac), and simazin and its analogues. The latter two at heavier rates may act as soil sterilants.

If it is considered expedient, soil sterilants may be used on patches of dandelion, Canada thistle and sowthistle. In Saskatchewan, these weeds are invading south-westward into previously uninfested areas. Soil erosion is often a problem in this part of the province, necessitating the substitution of 2,4-D for tillage in the control program. For instance in the fall, 2,4-D may be substituted for tillage. During the summerfallow year also, an application of 2,4-D ester at 1½ lb/A may substitute for one and sometimes two tillage operations. This procedure permits control of perennial weeds without aggravating the problem of soil erosion. 2,4-D and MCPA are effective for top growth control of these weeds in crops. 2,4-DB and MCPB show promise for top growth control in legumes, while amitrol and 2,3,6-TBA appear to be effective on non-crop land. A combination of MCPA and sodium chlorate, and the herbicides simazin, silvex, and 1,1'-ethylene-2,2'-bipyridinium dibromide (FB-2) appear to be effective enough to warrant further testing. TBA or amitrol at 14 lb/A, or two applications (one each) at 4 lb/A has been shown to eradicate dandelion, but two applications of 2,4-D at a similar rate is also effective. 2,4-D therefore, appears to be the most practical herbicide to use. Chlorate-borate compounds are still effective on persistent perennial weeds, with borax derivatives being particularly effective on leafy spurge and toadflax. Borax and BDM are about equivalent pound for pound on toadflax and excellent control has been obtained with rates as little as 1 to 2 lb/100 sq ft. On leafy spurge, one pound of a BDM appears to be slightly more than equivalent to 2 pounds of borax. Excellent control has been obtained with a BDM at 1½ lb/100 sq ft at a cost of approximately $75.00 per acre. The substituted urea compounds are also effective, but in my opinion should not be used for the control of toadflax and leafy spurge. They are more effective for grass control than for these persistent perennials, thus eliminating competition by grasses. At Saskatoon, re-invasion of leafy spurge and toadflax occurs first in heavily treated plots where competing grasses have been killed out. Indeed, monuron at a rate of 50 lb/appeared to fertilize leafy spurge. Repeated applications of 2,4-D at a rate of 2 lb/A show promise for eradication of leafy spurge. Eight or nine applications over a period of two years at Saskatoon have provided complete eradication, at a cost of approximately $25.00 per acre. If this method continues to be effective, it may have an application in the control of large and extensive infestations in conjunction with competition by grasses. Herbcides which show promise for leafy spurge and toadflax are amitrol, TBA, a mixture of chlorinated benzoic and cresoxyacetic acids (CP 1815), 2,3,6-TBA, and simazin and its analogues.

2,4-D and MCPA are currently recommended for top growth control of field horsetail in field crops and recent tests have shown that amitrol and CP1815 may have a place in the control of this species. Monuron and the chlorate-borate compounds are recommended for Russian knapweed and the hoary cresses, but borax does not appear to be particularly effective. There is a possibility that a BDM in excess of 4 lb/100 sq ft may be effective on Russian knapweed and TBA shows promise for the control of Russian knapweed and poverty weed. Poverty weed is one which has been neglected from both the cultural and chemical standpoints. Further attention should be given also to repeated applications of 2,4-D for hoary cress, field bindweed and Russian knapweed as a means of eradication.

There are two concepts that are widely accepted in perennial weed control that I think require further consideration. One is that since food reserves of underground parts reach a low ebb in the bud stage, it is at this stage that systemic herbicides should be applied. Preliminary experiments at Saskatoon with leafy spurge, toadflax, couchgrass and absinth indicate that initial applications in the late flowering stage are more effective. Similar results have been reported by Derscheid[2] with leafy spurge and Russian knapweed and by Sand[2] with hoary cresses. Crafts[3] states that dosage rate must be regulated in order to utilize the mechanism of translocation in the control of perennial weeds. This would suggest that a point should be reached whereby an increase in dosage would provide less effective control. In three years of experiments with a variable rate sprayer at Saskatoon on leafy spurge, absinth, dandelion and toadflax, with herbicides such as 2,4-D and MCPA formulations, 2,4,5-T, and some of the newer herbicides

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with rates up to 40 lb/A, in no instance did a heavier application result in less effective control.

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[1] Dept. of Plant Ecology, Univ. of Sask., Saskatoon, Sask.
[2] Leafy spurge. Russian knapweed. Hoary cresses. Proceedings of the fifteenth annual meeting of the North Central Weed Control Conference. 1958. pp. 50-52, 54.
[3] Crafts, A. S. 1956. Translocation of herbicides. Hilgardia 26: 287-335.

CONTROL OF HARD TO KILL ANNUAL WEEDS

Forsberg, D. E.

Weed species with widely different growth characteristics infest much of the farm land in Canada today. Because of this wide range in weed species there is no single mechanical or chemical control method universally applicable to the different crops grown in a region. The weed research man is faced not only with a multiplicity of problems as regards crop to weed relationships, but also with soil and climatic variabilities which add complications to the development of suitable weed control programs. Great diversity in acreage devoted to a grain crop between farmers imposes limitations on research directed towards developing equipment and control methods suitable for both large and small production units.

Hard to kill annual weeds have received considerably more attention in the last five years than they have had in the previous five years. This has been mainly due to the fact that they formed the minor part of a weed association some ten years ago. With the advent of chemical weed killers the susceptible weeds and thus their competition have been largely eliminated. Consequently, hard to kill annual weeds have flourished and spread in the last five years although chemical weed control is now a recommended and widely accepted practice.

It is not possible within the scope of this talk to treat all the various weed problems and advances made in their solution by using chemical and cultural methods. Attention will be given to weeds and weed problems on which most progress has been made and those which are of economic importance in Western Canada. Some of these are: wild buckwheat, tartary buckwheat, hemp nettle, green foxtail, and ladysthumb.

In starting a control program for the control of annual weeds one has at least three avenues of attack: cultural control, herbicidal control, and a combination of the two.

From his work on the control of annual weeds by cultural methods, Chepil concluded that weed species differed widely in their length of dormancy, in their distribution of germination throughout the growing season, in the viability of their seeds and in the quantity of seed produced. This situation necessarily makes the control of weeds by tillage and cropping practices exceedingly complicated because seldom if ever is the farmer faced with only one weed species.

The length of dormancy of the seed would appear to be the major single factor responsible for the seriousness of a weed species. At present there is no practical way of eliminating weeds having long dormant periods. The summerfallow, which is highly effective in the control of weeds with a short dormant period, is only partially if at all effective in the eradication of those weeds with a long dormant period. Periodic clean summerfallow, combined with practices that prevent re-infestation of the soil with seed, would eventually reduce the weed infestation to a level where it would no longer menace crops. At present, our soils are so heavily infested with seed that this would take many years, even if no further weed seeds were allowed to mature.

It might be pointed out that the heaviest germination of most weed seeds takes place in the spring with little subsequent germination, regardless of the number of cultivations. This largely explains the difficulty encountered when attempts are made to germinate and kill by tillage, successive crops of weeds during the fallow year.

Since the summerfallow can only be relied on to aid rather than to solve the weed control problem it is necessary to employ other methods such as fall tillage, delayed, and post-seeding tillage to obtain a further measure of control for certain annual weeds. How to use these practices will be discussed later on as individual weeds are discussed.

The second method of attack is by the use of selective herbicides. Some of the important aspects of successful weed control with herbicides are: 1) spray early; 2) use enough herbicide; 3)know your weeds; 4) know your herbicide; 5) know your crops; 6) know the precautions to take to prevent unnecessary damage to sensitive crops.

The control of hard to kill annual weeds by combining chemical and cultural methods has only been applicable during the summerfallow year when a tillage operation is substituted with an application of some chemical. Most of this work has not been very successful on annual weeds but has been quite successful in the control of some perennial weeds.

Recent Development in the Control of Wild Buckwheat

Wild buckwheat a native of Europe has been introduced into this country and has increased until it now ranks second to wild oats as the worst annual weed menace. Manitoba has an estimated 4,000,000 acres infested one-half of which is heavily infested, while Saskatchewan has 7,000,000 acres or 20 percent of the cultivated acreage heavily infested. In Alberta it is found on over 3,000,000 acres with about 500,000 acres heavily infested. Wild buckwheat is a strong competitor for nutrients and light. Its twining habit of growth tends to cause the grain to lodge, which makes harvesting difficult and losses are often high.

Work on the control of wild buckwheat in recent years has been confined to studies on seed dormancy, plant development and chemical control. Studies on seed dormancy have revealed that wild buckwheat seed possesses a dormant period which will enable viable seed to remain in the soil for a number of years. The hard outer seed coat is impervious to water and unless the seed coat is cracked or scarified by natural agencies it will not germinate.

The studies on plant development would indicate that seedlings of wild buckwheat will emerge from depths down to 3½ inches, beyond which we can expect very little emergence. Wild buckwheat usually starts to germinate early in May and continues to germinate into September. However, the most germination will take place in May and during the first week of June. Early germinating buckwheat will start flowering late in June and continue to flower and produce seed until freezeup in the fall. One good healthy plant of wild buckwheat is capable of producing approximately 4,500 seeds per growing season.

Studies on the competition of this weed on oats and flax have shown that 15 plants per square foot is sufficient to reduce the yield of oats by some 55%, and in flax only 3 plants per square foot will reduce the yield by some 66%.

This information is useful for a cultural control program. In areas or fields known to be heavily infested with wild buckwheat a method of delayed seeding can be employed to kill a crop of wild buckwheat before

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seeding a grain crop. At Scott this delayed seeding has resulted in a 96 percent reduction in wild buckwheat, compared to early seeding.

Chemical control of wild buckwheat has been the major study during the past five years. Out of these studies has come our present recommendation to utilize a double application in its control. Although this method of control has resulted in the highest degree of control it has not been well accepted by farmers. Timing of applications and the extra work involved in making the second application have been its main drawbacks. With this in mind, new herbicides are continually being screened of which a single application might be used.

It was found that the time of applying an herbicide was important. Usually when buckwheat is in the 1 to 2 true leaf stage, most cereal grains are in a stage that is safe to treat, a highly desirable stage so far as crop and weed is concerned. However, much better control has been obtained when spraying was done at the most susceptible weed stage, regardless of the crop stage. Spraying when buckwheat is in the cotyledonous leaf stage, when grain is just emerging or in the first leaf, has resulted in a higher degree of control and no reduction in yields when compared to the untreated check plot. At Scott this yearly spraying has been conducted for the past four years and the results are presented in the following table. The yield data are bushels of wheat per acre while the bracketed figures are the average percent kill of wild buckwheat over the past four years.

Treatment	Rates of application in oz/A					
	5	8	12	16	32	5+5
2,4-D butyl ester	19(85)	18(87)	17(89)	19(91)		19(89)
Butoxyethanol ester of 2,4-D	19(87)	19(90)	18(89)	17(89)		17(92)
MCPA butyl ester	20(68)	20(75)	18(71)	19(75)		19(78)
4-(MCPB) butyl ester	16(64)		15(66)	14(63)	15(70)	16(61)
4-(2,4-DB) butyl ester	15(65)		13(78)	14(85)	13(89)	13(82)

Av. untreated check yield 18.8 bu/A

These data indicate that a fairly high degree of control can be obtained by spraying at this early date with no apparent reduction in yield when compared to a weedy check. However, yields are apparently reduced when compared to a weed-free crop, and deformities are prevalent in a crop of wheat when these treatments are used. The significance of these data would be that, in areas heavily infested with wild buckwheat, a degree of control can be obtained which would be better than no control, when double applications are not used.

In 1958 an herbicide called neburon resulted in 100 percent kill of wild buckwheat in fields of wheat, oats and barley. However, further testing showed that 100 or more gallons of water per acre were required to give this result. Consequently, the chemical has been dropped for the control of wild buckwheat.

During the summer of 1959 several low-volatile esters were used on wild buckwheat. These were received from several chemical companies across Canada and the United States. In essence, we were testing different formulations and sources of low-volatile esters for the control of wild buckwheat. Out of the 15 low-volatiles under test only four resulted in 100 percent kill when sprayed at the 6 to 8 leaf stage of wild buckwheat, when wheat was in the shot blade. Three of these caused significant yield reductions, which probably could be expected when spraying a crop of wheat at this stage. However, the fact that one of these low-volatile esters resulted in 100 percent kill and no yield reduction is certainly encouraging, and we can probably look to a future when a single application of an herbicide will be sufficient to control wild buckwheat.

Recent Development in the Control of Tartary Buckwheat

Another introduced annual, tartary buckwheat, has become widespread in north central Alberta where over 2,500,000 acres are estimated to be infested, with over 500,000 acres heavily infested. The infested area is growing larger and in recent years has spread into northwestern Saskatchewan. Only one infestation of some 300 acres has been reported in Manitoba. Because it is similar in size, the seed of tartary buckwheat is extremely difficult to remove from wheat, oats, and barley and, under the Canada Seeds Act, grain containing it may not be sold for seed. Commercial grain containing these seeds is severely degraded. As an impurity in wheat, the seed causes discolored flour. Consequently, the spread of this weed is being viewed with alarm in western Canada.

As with wild buckwheat the seed of tartary buckwheat possesses a dormant period. Studies on seed dormancy at the University of Alberta have not revealed the causes of dormancy. However, Vanden Born and Corns concluded: "The significance of some of these findings in weed control methods may become evident, for example, where fall tillage immediately following harvesting is practised. In fields infested with tartary buckwheat many mature seeds of this species will be left on the ground when harvesting is complete. If the weather has been hot and dry for a few weeks, prior to and during harvesting, the majority of the seeds on the ground will have lost their dormancy and the field may be tilled without much danger of burying dormant seeds in the soil. Under favorable moisture and temperature conditions following tillage, the majority of seed covered up will germinate, and emerging seedlings may be destroyed by further cultivation or by frost. If, on the other hand, the weather has been cool and wet mature buckwheat seeds on the plant and on the soil surface will after-ripen very slowly. Immediate tillage will result in covering up these dormant seeds, and long periods may elapse before they after-ripen sufficiently to germinate and grow. The indication is, therefore, that under cold wet conditions tillage should be delayed at least until the following spring, when the seeds have had sufficient time to after-ripen."

Eradication of tartary buckwheat by chemical means appears to be impractical at the present time, but with the present herbicides and recommendations it is certainly possible for farmers to keep the weed under control. Again, as with wild buckwheat, 2,4-D should be applied as early as possible and as heavily as possible, which depends on the grain crop to be sprayed. The rates used should be 6 to 8 oz/A depending on the cereal crop. Studies have indicated that low-volatile esters of 2,4-D are more effective than the standard 2,4-D esters, and MCPA ester much inferior.

Recent Developments in the Control of Green Foxtail

Another annual weed which has caused concern in recent years is green foxtail. This weed belongs to the grass family and cannot be eliminated from wheat, oats or barley as can broadleaved weeds. Consequently, most of the work on this weed has been with herbicides in crops of flax, rape and sugar beets.

Tests have been conducted on these crops with the sodium salt of TCA and dalapon. As with the two previous weeds, earliness of application is important. That is, flax should be from 4 to 6 inches high, rape should be in the 2 to 4 leaf stage and sugar beets should be in the cotyledonous leaf stage. These herbicides should be applied at 4 or 6 lb/A of TCA and .75 or 1.25 lb/A of dalapon. Better results are obtained with less damage to the crops concerned if 10 to 12 gal/A of water are used.

To indicate the importance of controlling green foxtail in flax, some figures from the Brandon Experimental Farm may be quoted. In a crop of flax 10 green foxtail plants per square foot reduced yields by some 59 percent, 50 plants per square foot reduced yields by 66 percent, while 600 plants per square foot reduced the yield of flax by 73 percent.

Very little work has been conducted on the control

of green foxtail by cultural methods. However, a degree of control may be expected from good seed-bed preparation and careful post-emergence harrowing of early sown spring grain.

As mentioned earlier in my talk hemp nettle and ladysthumb are two weeds that are also receiving attention in Western Canada. With regards to hemp nettle I find that there is very little to add to the present recommendation that has been in use for the past year or so. On the other hand, chemical control of ladysthumb has received some attention in the past year. Some of the low-volatile esters have shown promise in its control. However, due to a late harvest and poor weather conditions results are not available at this time.

In conclusion I would like to say that experimental work conducted by Universities, Experimental Farms, and the Chemical Industry, is proving beyond a doubt that weeds can be controlled effectively and economically with safety.

INDUSTRY'S ROLE IN WEED RESEARCH

R. A. Fosse[1]

We in industry are very proud of the contributions we have been able to make in the field of herbicides. We are particularly proud of the excellent relations and cooperation which have been maintained with all groups working in the weed control field, including county agents, agricultural representatives, weed supervisors, experiment stations, regulatory agencies and the Federal agencies.

The word "industry" in the field of herbicides takes in a rather large and diversified group. We have among our manufacturing companies those few who are basic in the raw materials needed to produce herbicides. We have other companies which are formulators, usually buying the technical material and specializing in economical, efficient formulation and distribution of the chemicals so that they can be used by the consumer. We have another group who buy esters, amine and some formulated products who simply finish formulations or repackage for consumer use. Industry also includes jobbers, dealers, custom sprayers and the manufacturers of spray equipment. So, you see, we include quite a large group when we use the word "industry."

At this time, I would like to talk to you about research as conducted by the herbicide manufacturer or formulator. I will be drawing my information from experiences within my own company and from associations with other companies in the field as well as some of the information which has been published on this subject. I will try to acquaint you with some of the problems confronting the research man in industry, covering the problems of screening for new herbicides, formulating and developing new herbicides, with particular emphasis on the phase of the program up to the time the chemicals are sent to the colleges and other cooperating agencies.

The screening of new compounds for herbicidal activity is primarily a function of industry. It is a function which, of course, can be done best by industry since they have the chemicals and chemists available which are necessary to perform this job. One of the main reasons that industry must be involved in this phase of weed research is that it makes it possible to gain patent protection on materials which will in turn enable them to price products in order to allow a suitable margin of profit to cover operating and the costs involved in getting a product on the market. A recent article estimates that the cost of research to develop a single insecticide are just under one and one-half million dollars. DuPont has reported that the cost of discovering and developing the urea herbicides exclusive of production and distribution now totals more than three million dollars.

Why are these costs so high? To begin with, we figure we must synthesize and screen about two thousand to three thousand compounds to find one with enough activity to warrant further testing. This has been estimated to cost seventy thousand to one hundred thousand dollars. To study patentability, test closely related compounds or isomers for patent purposes and file patents —eight thousand dollars. To field test a chemical, study and evaluate data, and send out samples—half a million dollars. To set up a pilot plant to produce enough for field testing—fifty thousand dollars. To develop analytical methods for residue studies, about one hundred and thirty thousand dollars. Then, we must use these methods to analyze our crops for undesirable residue or flavor and run acute and chronic toxicity studies. This may cost over two hundred thousand dollars. The costs add up quite rapidly. All of us who play a part in producing our nation's food supply feel and accept a strong responsibility to see that the products and services we contribute do not introduce a hazard to human health. The necessary toxicity studies add much to the cost of introducing a chemical; however, this is an accepted and essential part of the business.

The screening of chemicals presents many problems which must be answered. Before there is any hope of screening for a chemical to answer a given problem, the persons in industry responsible for a screening program must know the problems and potentials involved. In order to stay in business, it is recognized that a company must show a profit. We, of course, can only stay in business if we, in turn, can show a profit to the consumers of our product.

One of the big problems in industry's screening program is developing satisfactory techniques of screening materials which will give rapid answers as to whether a chemical has possibilities for answering a problem.

Once a new herbicide has been found in our preliminary screening program, several groups in industry go to work gathering information which is necessary before a material can be marketed. Many of these groups work simultaneously.

Secondary screening and small-scale field testing is ordinarily conducted before the chemical is sent to the public agencies for their evaluations. The purpose of this secondary screening is to determine where the chemical fits by discovering its possibilities and limitations. In our secondary program, we maintain an experimental farm which is devoted primarily to the secondary testing of new chemicals. We don't feel that all of the potential problems which are encountered around the country are covered by our secondary screening program. There is a great lack of information as to how big a problem certain weeds are and what they cost in terms of loss of production, hazard to health, fire hazard, etc. We endeavor to get this information. However, we must rely on local people, such as yourselves, to gather and present this information to us. If we are not aware of your problem, the chances of finding a solution to it are quite minute.

At the same time the secondary screening is taking place, toxicity tests are usually initiated. At least two years are necessary to complete the toxicity tests on any new chemical. Preliminary information on the toxicity of a chemical can be determined by determining sooner what is called the acute LD50 on certain animals. Final toxicity tests, however, also include two-year feeding studies on animals to determine if there is any build-up in the body or accumulated toxic effect through continuous consumption of the chemical.

Another group that usually goes to work simultaneously with, or just before, the secondary screening, is the formulating group. It has been pointed out in the past that formulations play a very important part in the effectiveness and usability of a chemical. This group of chemists endeavors to determine the best commercial

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formulations for the chemical. Up to this time, the chemical may have been in a very expensive solvent, or possibly at a very low concentration unsatisfactory for commercial merchandising methods. It is now the task of the formulator to use the proper combination of solubilizing agents, emulsifiers and wetting agents in order to make a balanced formula for the chemical that will be commercially acceptable as far as cost, effectiveness, storability and toxicity are concerned.

The chemical formulation of herbicides has moved through several stages of development. In the early days of 2,4-D, we had salts, carbowax emulsions and low concentration esters. The salts were improved and the carbowax products were discarded when low volume spraying made its appearance. The concentrated esters and amines were introduced because of their ease in application and because of the need for two distinct formulations for use under the great variety of crop and weed conditions.

Even at that time differences were acknowledged in the selectivity and killing power of salts, amines and esters. At the present time, most of the conference recommendations state that esters should be used at a certain acid rate per acre and that amine dosages should be nearly doubled in comparison. These recommendations point out the difference the formulation makes when comparable amounts of 2,4-D are used. Nevertheless, we frequently hear people say there is no difference between 2,4-D formulations; that it is the amount of 2,4-D acid that counts, without further explaining the differences in performance of the salts, amines or ester forms. Recent work with the 2,4-D butyric materials has pointed out that there is a marked difference in the response of crops to esters and amines of this material. Peas can be very severely injured by the ester forms of the butyric while the amine forms at the same rate of acid per acre have caused little, if any, damage.

After secondary screening has shown the possibilities and limitations of the materials, toxicity tests have shown the safety of the material for use, and formulation chemists have found a satisfactory formulation, a material is released through the various experimental agencies for evaluation under local conditions. I might point out here that different companies handle this in different ways. Some of the companies continue to do much of the field testing under their own supervision while some of the other companies will submit the report on their finding of the chemical to the experiment station or other public agency for their evaluation. In the biological field, it can never be assumed that if a material works under one condition it will be as satisfactory under another condition.

In addition to the research which has just been discussed, the industry also does research in other fields which you are all probably aware of. We do or sponsor a certain amount of fundamental studies on the mode of action of chemicals and on the rate of disappearance of the chemicals in soils and plants. In areas where there is not an active public agency we may go into more of the field of applied research and even into demonstration of a chemical. In the field of general vegetation control and brush control, we work directly with many other industries, such as the railroads, the timber companies and power companies.

In summary, weed research as conducted by commercial concerns is directed toward answering the problems which confront our customers. We try to recognize the needs of these people and provide them with the best answers possible. Some time ago, I heard a speaker say that he didn't know how many quarter-inch drills were sold in this country, but that he assumed there were a great number of them. In spite of this he was sure that nobody really wanted a quarter-inch drill, but what they really wanted was a quarter-inch hole. By the same token we are sure that nobody wants a 5 gallon can of 2,4-D but what they do want is the economical and efficient elimination of weeds in their crops. This is what we are endeavoring to provide.

[1] Amchem Products, Inc., Niles, California.

HERBICIDAL DRIFT AND HORTICULTURAL CROPS

E. K. Alban[1]

There are many available herbicides that can be safely used in or around horticultural crop plantings with no real hazard. However, there are two herbicides —2,4-D and 2,4,5-T—which can cause considerable damage to horticultural crops when they are improperly used adjacent to or in the general vicinity where these crops are grown.

Growers of horticultural crops are rightfully concerned with the monetary loss they are experiencing through the misuse of 2,4-D and 2,4,5-T. Grape growers have suffered reduced yields, poorer quality of the harvested fruit, and occasionally loss of plants in the vineyard. In addition to the damage experienced in the season of initial spray drift, grapes often reveal continuous ill effects for several years after the original symptoms were noted. Tomato growers have seen reduced yields, delayed maturity, and poor quality fruit following the chance exposure of tomatoes to these chemicals. Most flowers, fruits, vegetables, and ornamental plants are mildly to severely damaged following exposure to these chemicals. Damages are often difficult to evaluate since time, environmental conditions, and other factors determine plant recovery.

Horticultural crop susceptibility to 2,4-D and 2,4,5-T is not a new problem but has been with us since the expanded use of these chemicals beginning in 1946. A re-statement of the problem would include (1) No horticultural crops are completely tolerant of these two chemicals, (2) Most horticultural crops can be severely damaged and many killed through misuse of these two herbicides, (3) The actual extent of damage to a plant or a planting is usually very difficult to evaluate, and (4) The question of "Whose 2,4-D or 2,4,5-T caused the damage?" is often the most difficult one to answer.

Many users of 2,4-D and 2,4,5-T do not realize, until too late, that they must learn to confine these chemicals within the sprayed area. There is much discussion about volatility, drift, safe distance to spray, wind and temperature at time of spraying, formulations, type of equipment, spray pattern and particle size, etc. as related to safe use of these chemicals. While it is perhaps not possible at the present time to answer all of the questions raised above, certain concepts of safe use of these chemicals would involve the following:

(1) Acquaint all spray rig operators with the idea of safe use of these chemicals.

(2) Accept the idea that there are some areas of concentrated horticultural crops where the hazard of spraying is too great to warrant their use.

(3) Do not use these chemicals when the prevailing wind will blow the drift or spray to susceptible crops.

(4) Realize that in spraying on a calm day, with high temperatures and a large acreage, that a cloud of 2,4-D or 2,4,5-T spray particles or volatile fractions may move for a mile or more from the sprayed area.

(5) In spraying areas where there would seem to be a hazard to adjacent susceptible crops, consider the following:

(a) Use an herbicide that will not injure the adjacent crop.

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(b) Use the amine salts or the low-volatile esters rather than the more volatile butyl, propyl or similar ester forms.
(c) Do everything possible to increase the particle size, i.e., increase gallons of water used per acre, use larger nozzle aperture, reduce pump pressure, decrease speed of application rig, and keep the nozzles as close to the ground as possible.
(d) Use these chemicals in the season of the year when there would be a minimum number of susceptible crops growing, i.e., early spring, late summer, autumn, or winter period.
(e) Avoid spraying these chemicals when the air temperature is above 80°F.

(6) Remember that a cheap answer to your weed control problems may result in an expensive claim for damages from your neighbor who is growing horticultural crops.
(7) Safe use of 2,4-D and 2,4,5-T will continue to benefit all of agriculture as long as we recognize *safe use*.

Chemical control of weeds and brush represents one of the greatest advances of the twentieth century. Continued acceptance and future development of this new science and industry would seem to be definitely associated with greater emphasis on consumer education in the safe use of 2,4-D and 2,4,5-T.

[1] Dept. of Horticulture, Ohio Agr. Exp. Station and The Ohio State University, Columbus 10, Ohio.

PANEL DISCUSSION: WEED CONTROL IN HORTICULTURAL CROPS

G. F. Warren[1]

Hand weeding vegetable crops is a costly operation, often exceeding $100 per acre. Fortunately selective herbicides can now be used on several of these crops to greatly reduce this cost. With carrots, the treatment is so effective that nearly 100% of the commercial crop in the United States is sprayed with Stoddard solvent or related petroleum products. While we do not have as universally effective a treatment for onions, most of those grown in the northern states are at least partially weeded with chemicals.

In spite of these examples of successful use of herbicides there are many vegetable crops where we still have none that can be recommended. In other crops, the treatments now recommended are far from ideal. Therefore, the search for new materials and improved techniques of application continues at an ever-increasing tempo as labor costs continue to soar. A few of the promising new developments will be summarized here.

A new approach to selective weed control in transplanted crops is the use of granular herbicides. Many pre-emergence herbicides can be applied in a granular form soon after transplanting a crop and avoid contact injury to the foliage that so often occurs when they are applied as sprays. In tomatoes, this method of application is especially promising. CDAA, Amoben (3-amino-2,5-dichlorobenzoic acid) and DAC 893 (dimethyl 2,3,-5,6-tetrachloroterephthalate) are some of the materials that have given encouraging results on tomatoes when applied in granular formulations.

Another recent development is the introduction of new selective post-emergence herbicides. Particularly promising in this group are Karsil [*N*-(3,4-dichlorophenyl)-2-methylpentanamide] for carrots, parsnips and other Umbelliferae. Solan [N-(3-chloro-4-methylphenyl)-2-methylpentanamide] is a close relative and is the first herbicide to show apparent post-emergence selective action on tomatoes.

Several new pre-emergence herbicides are being widely tested which show selective action on various vegetable crops. Amoben has a long residual life and several crops have shown good tolerance to it. Among these crops are pumpkins, squash, snap beans, sweet potatoes, asparagus and carrots. DAC 893 is a pre-emergence chemical that shows striking selectivity. Sweet potatoes, snap beans, onions, and several other vegetables appear resistant to its action. Most annual grasses and many broadleaved annuals are susceptible but, as might be expected in a highly selective material, some weeds are resistant. Notable among these is smartweed.

All these developments are most encouraging and indicate that we can look forward to a time when we may be able to eliminate the hand labor now required to remove weeds from our vegetable crops.

[1] Purdue University, Lafayette, Indiana.

WEED CONTROL IN SUGAR BEETS IN MANITOBA

J. W. Hall[1]

Wild oats and green foxtail are the most widespread weeds in the sugar beet fields in Manitoba. Beets are grown in what is predominately a cereal crop area. The herbicide program in the cereal crops greatly reduces the problem of broadleaf annuals in sugar beets. Beets should not be planted in fields infested with perennial weeds.

The control of broadleaf weeds with herbicides has not been successful. Endothal damages beets at rates that will control weeds. Some herbicides tested for the control of grasses in sugar beets are listed.

IPC at 4-5 lb/A and Avadex (2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture) at 2 lb/A well incorporated into the soil are recommended for pre-planting application for control of wild oats.

Carbyne at 1 lb/A over-all will be used for control of wild oats on a trial basis where conditions warrant in specific cases. It is applied as a post-emergence spray and has shown good prospects in tests over the past two years.

TCA at 4 to 6 lb/A over-all applied either as pre- or post-emergence spray is very reliable for the control of green foxtail.

Dalapon performance as post-emergence treatment for wild oats has been very erratic in performance. It has not proved as reliable and satisfactory as TCA under our conditions for control of green foxtail. Damage to beets is more pronounced than with TCA.

In commercial treatment, band application, where practical, can reduce the listed rates by two thirds.

[1] Agricultural Superintendent, Manitoba Sugar Co.

WEED CONTROL PRACTICES IN BULBS AND ORNAMENTALS

R. M. Adamson[1]

Spring flowering bulbs, which include narcissus, tulips, bulbous iris and Easter lilies, are grown mainly in the Pacific Northwest and all are expensive to weed by hand. The rainy season commences shortly after planting and ridging up in the fall, and the soil soon becomes

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wet and remains so for six months or more. Under these conditions chemical weed sprays have proved very effective. In coastal British Columbia a combination of monuron at 2½ to 3 lb/A and CIPC 4 lb/A, applied before or at weed emergence in the fall, is effective for broad-leaved weeds, grasses and volunteer cereals, often giving weed-free conditions until bulb harvest the following July. In western Washington DNBP amine at 4½ lb/A is recommended for fall spraying with CIPC at 4 lb/A added where grasses or cereals are a problem. For spring-emerging weeds in bulbous iris only, an April or May application of monuron at 0.8 lb/A is recommended, while for tulips and narcissus CIPC at 4 lb/A has proved safe and given fair control. Recently diuron has been suggested for fall application at 3.2 lb/A.

For control of weeds in Easter lilies, which are grown mainly in Oregon, the DNBP amine-CIPC combination has been effective, while repeat treatments of sesone have been used for spring and summer weed control.

The control of weeds in commercial ornamental nurseries is a problem which has been investigated widely within the last two or three years. Simazin applied shortly after planting out has shown a great deal of promise. Experimentally, rates have varied considerably, 2 to 4 lb/A being effective in trials in the north central area, while 5 to 6 lb/A have given best results in Washington and British Columbia. With a few exceptions narrow-leaved evergreens have shown considerable tolerance to simazin, while among the broad-leaved evergreens and deciduous shrubs there is greater variation in sensitivity. With research now being undertaken on different aspects of the problem, such as effect of herbicides on various species, the role played by temperature and different soil types, and investigations into chemical seedbed sterilization, the prospects of developing safe and effective controls for ornamentals are bright.

[1] Experimental Farm, Canada Department of Agriculture, Saanichton, B. C.

WEED CONTROL IN SMALL AND TREE FRUITS

M. G. Oswell[1]

Tree fruit and small fruit production in Western Canada is centered in British Columbia. Tree fruit orchards are largely located in the interior valleys, the Okanagan Valley being the most important, and small fruits are limited to the Coastal regions of the Province. In tree fruit orchards couchgrass is considered the most serious weed and will compete with fruit trees for moisture and nutrients. Almost all weed control practices are carried out with cultivation equipment although around the base of trees such equipment is likely to cause injury to trunk and roots. As hand labor to control vegetation around trees is costly, chemical weed control is being used on a very limited basis. In the production of small fruits (strawberries, raspberries, etc.) a certain amount of hand labor is used to reduce the weed growth. In order to use less hand labor weed control with herbicides has become an established practice. Experimental work is being carried out in tree fruits and in small fruits to find materials and to develop methods that are less likely to cause injury. Greater use of chemicals for weed control will be carried out as the amount of costly hand labor involved in hand weeding can be significantly reduced.

[1] British Columbia Dept. of Agriculture, Vernon, B. C.

CYTO-HISTOLOGIC RESPONSES OF WHEAT AND WILD OATS TO CARBYNE

Kenneth P. Dubrovin[1]

The mode of action of Carbyne [4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate], a post-emergence wild oat herbicide, was studied by a histologic and cytologic investigation of the effects of this chemical in both wheat and wild oats.

Selkirk wheat and wild oats were planted in greenhouse soil in flats placed on benches in the greenhouse. Supplemental illumination, which consisted of fluorescent lights and incandescent lamps, was provided so that the photoperiod was equal to that found in North Dakota during the wheat growing season. Soil temperatures varied between 15 and 30°C. Carbyne was applied at ¼, ½, 1 and 2 lb/A in a spray volume of 10 gallons per acre delivered from a Sprajet nozzle No. 65.067 operated at 30 psi. Both wheat and wild oats were sprayed when the plants first emerged and thereafter at ½ leaf intervals of wild oats until emergence of its fifth leaf. Henceforth they were sprayed at intervals of one leaf until heading of the wild oats. The formulation used consisted of an organic solvent and an emulsifier.

Notes were made on plant heights, numbers of leaves and tillers emerged, and the stage of development. Plant samples of both treated and untreated plants were dissected and the numbers of unemerged leaves and unemerged tillers were noted. Some plant samples were preserved in solution and later were imbedded in paraffin and sectioned. These data were collected at short intervals throughout the entire growth period of the crops.

The shoot apex of wild oats sprayed during its vegetative stage, which occurred for 21 or 22 days following emergence, was very swollen and distorted when treated with Carbyne. Unemerged leaves as well as the bases of still elongating leaves, were likewise swollen. The tillers of inhibited plants were affected in a manner identical to that of the main shoot. The shoot apex of wild oats treated during the transition and floral stages was withered and shriveled as if it had been placed in a stream of hot, dry air. Wheat treated during its vegetative stage, which progressed during the first 11 days following emergence, swelled slightly. The swelling subsided and the normal manner of growth and development occurred. The effect on wheat treated during its floral stage was identical to that of wild oats treated during this stage.

Examination of slices of shoot apexes of treated wild oats showed swollen cells, many of which contained numerous groups of chromosomes. These groups had no nuclear membrane or nucleoli. Eventually large cells with no cellular material appeared in the apical portion of treated plants. In wheat a similar response was observed, but to a much lower degree.

This information indicates that Carbyne derives its herbicidal action from interfering in some way with normal cell division.

[1] Spencer Chemical Company, Kansas City, Missouri

COMPARATIVE EFFECTS OF AVADEX, CARBYNE, AND FENAC ON SEEDLINGS OF WILD OATS, WHEAT AND BARLEY

Corns, Wm. G.[1]

Wild oats, Parkland barley and Thatcher wheat were germinated in chemical solution in Petri dishes in the dark at 21°C. and in treated soils in the greenhouse, for comparisions of the development of shoots and roots of

the different species as influenced by the various herbicides and rates in the different media. The seedlings in the Petri dishes (25 seeds per dish) were kept for a week on filter paper moistened with 5 cc aliquots of aqueous solutions of 0, 0.5, 1, 2, 5, 10, 20, 30, 40, 50, 100, 200 ppm Avadex (2, 3, dichloroallyl diisopropylthiolcarbamate), Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) and Fenac (sodium salt of 2,3,6-trichlorophenylacetic acid), in triplicate experiments. The tests in the greenhouse included rates of 0, 1, 2, 4, and 8 lb/A of Avadex and of Carbyne and 0, 2, 4, 8, and 16 lb/A of Fenac in triplicate flats for each rate, each flat containing a row of each species seeded in black loam soil immediately after incorporation of the sprayed chemical in the top inch of the soil. Supplementary trials with gray-wooded, and sandy soil involved 1 lb/A of each chemical, replicated three times. Records included representative measurements and photographs of shoots and roots, tabulation of concentrations of chemicals causing incipient, and complete, inhibition of shoots and roots in the Petri dishes, condition, survival, heights and dry weights after one month's growth of the plants in the greenhouse. The concentrations in ppm of the herbicides causing A, incipient, and B, complete, inhibition of growth in the dishes were:

	Avadex			Carbyne			Fenac		
	W.O.	W.	B.	W.O.	W.	B.	W.O.	W.	B.
A.									
Shoots	1	5	5	1	5	2	2	5	2
Roots	1	5	10	1	5	1	10	10	2
B.									
Shoots	200	200+	200+	30	200	200	200+	200+	200+
Roots	100	200+	200+	20	200	40	100+	200+	10

Some differential selectivity was shown. Barley was more sensitive than wheat to Carbyne and more susceptible than wheat or wild oats to Fenac. Because of the small amount of Carbyne causing complete inhibition of wild oats, it was of interest to test this chemical with the others as a soil treatment. A partial summary of results with black loam soil treated with rates that provided the most instructive comparisons in the greenhouse shows survival, height and dry weight of plants as percent of check 1 month after soil treatment:

	Avadex 1 lb/A			Carbyne 1 lb/A			Fenac 2 lb/A		
	Surv.	Ht.	Wt.	S.	H.	W.	S.	H.	W.
W.O.	6	1	0.5	106	93	95	106	63	40
W.	37	27	7	100	93	94	105	54	28
B.	82	100	104	100	93	87	88	44	23

Here, Carbyne caused very slight injury to wild oats, in contrast with its effects in pure solution and with its beneficial effects as a selective foliage spray in other tests in the field (Research Report). In greenhouse treatments of sandy soil, Carbyne showed more marked injury to the wild oats and wheat than it did in the black loam soil, and there was an intermediate effect with gray wooded soil. Inactivation of Carbyne by black loam soil as distinct from leaching is thus suggested. Similar studies on other forms of Carbyne would be of interest. Avadex and Fenac showed similar, but much less marked, differences in response due to soil type. The table shows favorable results for Avadex in black loam soil, with wild oats and barley but not for wheat. A somewhat lower rate should be optimum for the greenhouse work but a higher rate (2 lb/A) gave 85% control of wild oats without damaging barley or wheat in black loam in the field trials (Research Report). Fenac injured wheat more than wild oats and was very toxic to barley in the greenhouse soils tests. No field tests were performed with Fenac, but the available data indicate little promise of satisfactory selectivity with this product.

[1] Division of Crop Ecology, Dept. of Plant Science, University of Alberta

A STUDY ON THE TOXIC MATERIAL FOUND IN COCKLEBUR

G. H. Egley and B. J. Rogers[1]

Cocklebur (*Xanthium* spp.) is considered to be a fairly poisonous plant in the seedling stage; however, it probably is not as toxic as either water hemlock or certain of the whorled milkweeds. It has been found to cause death in cattle, pigs, rice and rats, and probably is toxic to most, if not all, mammals.

In recent years the plant has decreased in importance because of the growing awareness among farmers of the toxic properties of the seedling. Still, it accounts for a number of deaths every year, particularly in young pigs. The symptoms include a general depression of the central nervous system, respiratory difficulties, and congestion in the stomach and intestines.

Cocklebur toxicity was reported first in 1880. For many years it was thought that the principal danger arose from the abrasive action of the burs, but Zander in 1881 reportedly extracted a glucoside (glucose plus some unknown compound) which was toxic. This he named xanthostrumarin. In 1930 an Italian worker reported the presence of an alkaloid in the dry burs. Krantz in 1943 found choline in water extract of burs and seeds. Hydroqinone was implicated by Kuzel in 1949. Any or all of these compounds probably could cause the observed symptoms.

Our work perhaps adds to the confusion. We have found that the toxicity resides principally in the seed and young seedlings. Mature parts of the plant are not particularly poisonous. Paper chromatography of water extracts of seeds and cotyledons indicated the presence of a phenolic substance (probably hydroquinone) and choline. In addition there is a third substance which is more toxic than either of the above.

This compound has not been characterized as yet. It is a small molecule, soluble in water and insoluble in non-polar solvents. It reacts with ninhydrin, sulfanilic acid, Ehrlich's and Dragendorff's reagents, and emits a white fluorescence under ultaviolet light. Toxicity is destroyed by heating in acid. The unknown compound depresses the central nervous system in rats, and also causes a slight inhibition of choline-esterase. From these observations we can say that it has a primary amine group and an aromatic ring of some kind. If it were a glucoside hydrolysis should increase the toxicity, unless the aglycone is unstable. The observations fit an alkaloid structure best.

[1] Purdue University, Lafayette, Indiana.

THE RELATIONSHIP BETWEEN MORPHOLOGY AND PERSISTENCE IN PERENNIAL WEEDS

Trilochan S. Bakshi and Robert T. Coupland[1]

It has been widely recognized that the behaviour of a plant is closely correlated with, among other things, its structure, and it is from the standpoint of structure that the problem of persistence of *Euphorbia esula* L. and *Linaria vulgaris* Hill is considered here. Anatomical studies of the subterranean organs of these species have revealed that some of their morphological characteristics are significantly related to their persistence. Two of these, the abundant accumulation of starch in and the presence of the typical open type of lenticels on the subterranean organs, appear to be correlated with the ability of the underground portions of the stems to propagate vegetatively. Thus *E. esula* possesses these characteristics and its underground stem produces numerous adventitious buds. *L. vulgaris*, however,

lacks these features, and it does not propagate vegetatively by means of its underground stem.

During the first year of the secondary growth in the roots of *E. esula* the primary cortex dies and is replaced by a secondary cortex produced by a continuous ring of pericyclic meristem. In this species lateral organ primordia may originate not merely from the pericycle opposite the protoxylem points, as is the case in most dicotyledons including *L. vulgaris*, but from any part of the pericyclic ring. Our studies have shown that nearly one-third of the total lateral organs in *E. esula* arise from the pericycle between the protoxylem arms. The pericyclic meristematic ring, therefore, adds considerably to the potentiality of this species in the production of lateral organs.

Differentiation of recognizable tissues in the primordia of lateral organs developing on the roots of *E. esula* does not take place while the primordia are within the parent root. In its earlier stages of development, therefore, a shoot primordium cannot be distinguished morphologically from a root primordium. This appears to suggest that the primordia, until their emergence from the mother root, are potentially capable of forming either a root or a stem, and that their ultimate fate is determined probably by the external environment.

In contrast to *E. esula*, where all later organs originate in the outer cells of the proliferated pericycle, in *L. vulgaris* lateral roots arise endogenously and lateral shoots exogenously. The shoot primordium always originates in the parenchyma of the primary cortex of the parent root and in the tissue juxtaposed with a lateral root. It is, therefore, possible that the lateral root produces certain hormones not produced by the parent root but necessary for the stimulation of the meristematic activity in the parent cortical tissues for the production of adventitious buds.

Our studies have revealed that *E. esula* is better equipped for vegetative propagation than *L. vugaris*. Nevertheless, in pure stands the number of shoots which emerge above the ground in a given area is generally less in *E. esula* than in *L. vugaris*. This makes *E. esula* a greater menace to farming than *L. vulgaris* since it has a good store of underground buds ready to emerge when its aerial parts are destroyed.

Soil disturbance has been found to have a deleterious effect on bud production in *L. vulgaris*.

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THE BIOLOGICAL AND PHOTOCHEMICAL ALTERATION OF MONURON

William Welker[1] and LeRoy Holm[2]

There is a most intimate and prolonged relationship of crop seed, weed seed, chemical, soil, and microbial life following the use of herbicides. It was during the course of an investigation of such a micro-environment, using radioactive monuron, that inconsistencies appeared in our experiments and valid measurements of activity became elusive. Certain aspects of the alteration of monuron may be discussed, namely: (a) following an early uptake of monuron by seeds and seedlings, the substance monuron is lost; (b) within the living tissues the substance monuron seems to lose its integrity and new substances appear; (c) ultraviolet light breaks up the molecule and irradiated solutions lose herbicidal activity.

A lengthy description of methods is unwarranted here for they are complex, but certain essentials may be in order. Radioactivity was measured with rather standard equipment with due regard for all precautions necessary when working with low activity (particularly in the soil experiments) and low energy. Much of the plant material was homogenized and measurements of activity were made on the supernatant. The monuron was labelled with C^{14} in the ring. The soil was organic. The plant was *Abutilon theophrasti*. All experiments and operations were suitably replicated.

While working with a model system in which radioactive monuron was mixed with moist soil and placed in a thin layer precisely at the seed level, it was noted that seedling exhibited a high level of activity at five days. Thereafter the activity declined. *Abutilon* seeds were then immersed in tagged monuron, removed, rinsed, and planted immediately in soil without added monuron. They were grown for several days in the light at 25° C. Imbibed seeds and seedlings were assayed daily for radioactivity. The activity dropped quickly from 130 counts per minute (CPM) per seedling at 2 days, to 21 CPM at 6 days. This loss was confirmed for plants grown in the dark.

The possibility existed that the loss was preceded by alteration of the molecule. In an effort to study this change, seeds were immersed in tagged monuron and again transferred to clean soil. The radioactive fractions were isolated, cleaned up, and chromatographed. By scanning the strips for activity with a thin window tube and by exposure of x-ray film, the presence of three radioactive substances may be shown in seedling 48-72 hours of age. These may be demonstrated with more than one solvent system. Seedlings of about seven days of age yield only two radioactive substances with these methods. Radioactive monuron was added to extracts from untreated plants to provide a standard of comparison for these measurements. The monuron spot absorbs and the other compounds fluoresce under ultraviolet light.

After locating the spots on the paper with use of radioactivity detection and ultraviolet scanning, the spots were carefully removed, eluted with alcohol, and absorption spectra were determined with a spectrophotometer. At this point it was discovered that the areas on the chromatograms which should have been comparable to pure monuron, did not give an absorption spectrum for this compound. After much distress and searching, it was found that the brief scan with ultraviolet light had altered the monuron. It was subsequently shown that monuron, which is quite stable to the action of acids, bases, and heat, is very quickly altered by ultraviolet light when exposed in a thin layer. Solutions of the chemical are similarly changed and acquire a reddish tinge. These solutions show greatly decreased activity in root elongation and seedling bioassays.

The results have been summarized in the early paragraphs of this paper but it appears that we ought to be reminded again of an important lesson to be gained from such experiments. Organic molecules (herbicides) which gain entry into living systems seldom remain intact. There is no assurance in these experiments, for example, that monuron is the only active fraction. When radioactively marked molecules have been permitted to enter, and when they are subsequently traced, we ought to define as best we can, what it is that we have found. In these experiments, we are reminded also of the danger in the employment of techniques which may produce artifacts of a nature to deceive us in the final interpretation of our results.

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STUDIES IN THE LIFE HISTORY OF ABSINTH IN SASKATCHEWAN

G. W. Selleck and R. T. Coupland[1]

Life history studies were initiated in extensive absinth infestations in the Cypress Hills, the Luseland-Denzil, and Penzance-Dilke districts in 1956. The latter two areas each represent infestations approximately 6 miles wide and 20 to 25 miles long. Eleven 0.5 meter belt transects were established in order to measure changes in extent of infestations and in the density of the weed in 16 habitats during 1956-59. The transects traversed native pasture, introduced grass pastures and cultivated land on dark brown soil of intermediate texture.

Natural colonization of the weed occurs entirely by seed, which germinates from mid-summer until fall, developing a rosette. Growth commences from these rosettes early the following spring, producing an inflorescence about mid-July and seed in late August to September. An established plant produces a crown up to 4 in. in diameter, with the stems occupying an area 8 in. in diameter at the soil surface. The crown produces up to 23 shoots five feet high, shading an area 4 ft. in diameter. Although roots produce shallow lateral branches from below the crown, there is no evidence of vegetative reproduction from them. New infestations may be initiated, however, from cuttings of underground parts and, therefore, may be spread from one place to another by farm machinery.

Disturbed areas provide conditions which are most suitable for the germination and establishment of seedlings. New infestations also originate on bare soil in overgrazed pastures, in disturbances made by rodents, or where existing vegetation has been killed out by hay coils, manure piles or standing water. In one study site in which a cultivated field had been seeded to *Bromus inermis*, the majority of the absinth plants became established where there was a poor catch of grass and, therefore, little or no competition for the weed. In autumn, seedlings commonly infest mature grain crops. In many areas, absinth becomes established first along ravines and infests adjacent areas from it. The weed is often found growing luxuriantly with western snowberry *(Symphoricarpos occidentalis)*. In better drained habitats the weed grows less luxuriantly and in dry habitats may be completely absent. Severe infestations of absinth are associated with severe pasture deterioration and reduced carrying capacity.

Native and introduced species of grass at different locations provided considerable variation in the degree of control of absinth. In west-central Saskatchewan at Denzil, patches increased in size during 1956-59 in overgrazed native pastures and in competition with bromegrass (Table). The density of the weed, however, decreased from 32.7 to 15.3 shoots per 0.5 sq. m. in competition with native grasses. The year 1956 being a season of abundant moisture, promoted a high seedling population, most of which died out during succeeding years. Abundant seed was available because of favourable weather in 1955. In competition with bromegrass many of the seedlings survived, increasing the density of the weed from 38.9 to 53.7 shoots per 0.5 sq. m. At Markinch, in a drier habitat, the infestation in native pasture decreased slightly in both the percentage of soil surface occupied and in density (Table). At the Cypress Hills, patches decreased markedly in size and density in competition with native and introduced grasses. Under cultivation, the density of the weed gradually decreased in every transect and under an efficient summerfallow program could be adequately controlled.

The percentage of infested area occupied and density per 0.5 sq. m. of *Artemisia absinthium* at various locations, 1956 and 1959.

Location	Overgrazed native pasture		Introduced grass pasture		Cultivated	
	1956	1959	1956	1959	1956	1959
Percentage of infested area occupied						
Denzil	35.1	91.0	18.0	48.7	72.2	11.4
Markinch	47.5	42.7	—	—	—	—
Cypress Hills	98.6	92.5	62.6	48.6	8.9	1.7
Density per 0.5 sq. m.						
Denzil	32.7	15.3	38.9	53.7	2.6	2.3
Markinch	28.1	23.4	—	—	—	—
Cypress Hills	19.7	7.5	7.5	2.4	1.2	1.8

Surface soil textures varied from loam to clay loam at all study sites. The driest habitat was considered to be at Cypress Hills, since the soil was underlain by coarse gravel at a depth of 8 to 12 in. The majority of the plants were tall and vigorous at this site in 1955, but with the advent of the dry years, most of the vegetative growth was confined to heights less than 6 in.

Although densities and sizes of patches generally decreased at Markinch, increases occurred in moist depressions. On dry knolls, dead plants were visible—plants which had succumbed as a result of two years of dry weather. Survivors were only 2 to 3 in. high, while in an adjacent moist ravine, plants were found growing vigorously at a height of 2 to 3 ft.

Most of our weed problems are associated with variables in climate and soil and absinth is no exception. Because of the noxious characterisitics displayed by this weed in pastures, cropland, farmyards and roadsides, measures should be taken to control existing infestations while they are still confined to local areas.

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CENTAUREA SPP. INFESTATIONS IN BRITISH COLUMBIA

A. J. Renney[1]

Recently in British Columbia we have become aware of the fact that we have a serious knapweed problem in the dry interior sections of the province. Several species of knapweeds are involved and at least one of them is not found elsewhere in Canada, although it does exist in several parts of the United States. Over the past two years we have been checking the infested areas and the species of knapweeds involved. The following report attempts to summarize some of the data which have been assembled. An E.M.R. grant from the Dominion Dept. of Agriculture has made this work possible.

Russian knapweed, *C. repens*. The earliest report of Russian knapweed in British Columbia indicates that it was present in 1920. The first plants collected in western United States were found in Kern County, California in 1914. Russian knapweed exists in scattered patches throughout the southern interior of British Columbia in an area bounded by Lillovet on the west, Cranbrook on the east and mile 141 Caribou highway, on the north. This constitutes an area of roughly 200 by 290 miles bordered on the south by the 49th parallel. With the exception of a large infestation in the Keremeos-Cawston area which amounts to perhaps 100 acres, other areas of *C. repens* seldom cover more than ¼ acre and most are small roadside patches. Cawston as a type area for Russian knapweed has a yearly precipitation of 9.8 inches (4.3 from May until September) and average July-August temperatures of 70.5° F. Russian knapweed was initially introduced through importations of Turkestan alfalfa seed and may also have been moved into

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the province through shipments of hay after the first introductions.

Diffuse knapweed, *C. diffusa*. This plant, which is not at present found in any other province, is the knapweed causing us the greatest concern. Apparently our earliest infestations occurred prior to 1930 as the weed was first noted at Lytton and Pritchard at this time. *C. diffusa* was collected in Klickitat County, Washington in an alfalfa field in 1907. *C. diffusa* is well adapted to the dry interior of the province. It has penetrated the coast range as far west as Canyon View, Boston Bar and Lytton on the Fraser River, and as far east as the Cranbrook-Kimberley area although very little exists between Monte Creek and Chase in the Kamloops area, and again near Vernon, Okanagan Falls, and west of Grand Forks. At Kamloops the yearly rainfall is 10.16 inches (May-Sept. 5.08) and average July-August temperature 69° F. The soils in the Kamloops-Chase area are classed as thin black lacustrine alluvium, with both river terraces and fans and rolling upland terrains. Although the same soils extend for over 100 miles south down the Nicola Valley, no diffuse knapweed has yet invaded this important ranching area.

C. diffusa establishes quickly on open, disturbed soil and textural groups in infested areas are usually medium to coarse. It is found most often as a weed of roadsides and waste areas but in several instances it has invaded range lands where it advances rapidly when fields are overgrazed or grass is scarce. Diffuse knapweed has also become a pest in public camping areas like the Vaseaux and Christina Lake resorts. While early growth is succulent, the plant is protected from grazing animals by its very bitter taste. Later as it begins to flower it becomes spiny and hard and at maturity a *diffusa* stand presents a formidable barrier to summer vacationers, particularly children. It is a common sight to see plants being carried along the highways caught on vehicles. Seed is distributed also by the tumbling of the mature plant.

Spotted knapweed, *C. maculosa*. Our first British Columbia collection of spotted knapweed was made in 1937. Washington records include a collection made in King County in 1928. The limit of *C. maculosa* infestation is approximately 65 miles north of that for *C. diffusa*. Although the spread of spotted knapweed in British Columbia has not been as spectacular as that of diffuse knapweed it is nevertheless giving cause for concern in some areas. In general, the areas infested by the two weeds are the same, inasmuch as they are both dry land weeds of the southern interior, but it is rarely that both species are present in the same place. Extensive infestations of *C. maculosa* occur on roadsides in the Canford area west of Merritt, the west arm of Kootenay Lake between Queen's Bay and Nelson, and in the Slocan Valley. In the Canford and Slocan Valley areas the weed has spread into hay fields and run down pastures but in general it has not been as aggressive as *C. diffusa* in colonizing range areas. Nelson and Canford as typical areas for *C. maculosa* have slightly shorter growing seasons than Kamloops and Grand Forks which are typical areas for *C. diffusa*, based on a 43° F. minimum, i.e. 199 and 196 days compared to 214 and 204. However, *C. diffusa* is found in areas in British Columbia with growing periods ranging from 190 to 235 days. Collections of *C. maculosa* have also been made in the coastal area in the past.

***C. diffusa* variants.** Possible hybridization between *C. diffusa* and *C. maculosa* has been suggested from time to time because of the variations which appear in populations of *C. diffusa* and the fact that heterosis might be enabling the knapweeds to offer strong competition to other forms. Moore and Frankton[2] have given the chromosome counts for *C. diffusa* and *C. maculosa* as 2n=18 and 2n=36, i.e. that *C. maculosa* is a tetraploid. In their materials they found no 2n=27 or triploid forms in those plants suspected of being hybrids.

A specimen called *C. divergens* collected in Grand Forks in 1939 by Eastham was identified as such by Abrams and was considered a possible *diffusa-maculosa* cross by Blake who was senior U.S.D.A. botanist in 1942.

***C. jacea x C. nigra*.** Another knapweed having a much larger flower than either the diffuse or spotted species also exists in British Columbia. The best known infestation occurs at Westwold, a settlement between Kamloops and Vernon. This species, which is a possible hybrid between *C. jacea* (brown knapweed) and *C. nigra* (black knapweed) has been called *C. pratensis* or hybrid knapweed by western American botanists. Frankton is of the opinion that neither of the parental forms exists in Western North America and certainly some of the specimens identified as either *C. jacea* or *C. nigra* in B. C. appear to be more like *C. pratensis*. The origin of this hybrid, which again may have been imported with alfalfa seed brought to the Western States or direct to British Columbia, is as yet unknown. Under our conditions *C. pratensis* or perhaps more correctly *C. jacea* X *C. nigra* has been advancing slowly and it is still confined to a few acres. Like Russian knapweed, the hybrid knapweed is perennial. *C. diffusa* is usually described as an annual or biennial, but under our conditions many specimens have been observed which are in their third year of growth. *C. maculosa* also commonly lives three years or more in British Columbia although it is described elsewhere as a biennial.

Garden escapes. Two other knapweeds occur as weeds in British Columbia. Both are garden escapes and infestations appear to be of little concern at the present time. These are *C. cyanus*, the well-known bachelor's button and *C. montana* or mountain bluet. Only two records exist of the latter species.

[1] Division of Plant Science, University of British Columbia, Vancouver, B. C.

[2] Moore, R. J. and C. Frankton. Cytotaxonomy of three species of Centaurea adventive in Canada, Can. J. Botany, 32: 182-186 January 1954.

OBSERVATIONS ON CHEMICAL CONTROL OF EXCESSIVE GROWTH OF CLADOPHORA IN LAKE ONTARIO

Duncan A. McLarty[1]

For the first time in many years excessive growth of *Cladophora* occurred along the northwesterly shores of Lake Ontario in 1957 and 1958. As a consequence a general study, supported by the Ontario Water Resources Commission, was undertaken in 1959. In view of the urgency of the nuisance problem, most attention was paid initially to the selection of a suitable algicidal chemical although some pertinent observations were made relative to the nature and conditions of growth of the alga.

Extensive, dense, *Cladophora* meadows occurred along the shore line in water up to six feet in depth wherever a suitable bed rock or "shingle" bottom was available for attachment. During the investigation, at least two distinct crops were encountered. The first, well established in June, produced a growth of two to three feet before becoming detached in early August. Much of the material accumulated and disintegrated on the beaches. At the same time a second crop was evident, coming at least in part from the perennial bases on the rocks, which persisted for the remainder of the season and attained a growth of approximately twelve inches.

Chemical control in this large body of water is rendered particularly difficult by virtue of the rapid dilution which may result from wave action and from pronounced shoreline drifts, by the persistent, low water temperatures and by the large amount of organic material, contributed almost entirely by the *Cladophora* it-

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self, with which one must deal. The existence of a perennial base, which is apparently quite resistant and productive, is a further complicating factor.

Test plots, measuring 100 x 200 ft., were buoyed off along the shore in the vicinity of Bronte, Ontario. Working from a small outboard motor boat crystalline copper sulphate was applied with a "Whirlwind Seeder" and Tricop Wettable Powder (tribasic copper sulphate) was applied using a burlap "drag." Atlas "A," a sodium arsenite preparation supplied by Chipman Chemicals Limited, and Hyamine 2389 (alkyl tolyl methyl trimethyl ammonium chlorides) of Rohm & Haas Company were deposited under water using a common hand pressure pump. Aqualin (85% acrolein) was applied by members of the Shell Oil Company of Canada and the Shell Chemical Corporation using a suitable power sprayer. Concentrations were calculated on the basis of total volumes involved and in terms of the compound concerned rather than the active component alone. Initial applications of chemicals were made on July 28 but no conclusions could be drawn by virtue of the subsequent maturation and breakdown of the entire crop. Applications made to the second crop on August 13, 19 and 20, however, were quite significant.

Copper sulphate crystals, applied at the rate of 2 and 4 ppm, and 5 ppm, applied as a solution, had little or no influence. Applied at the rate of 10 ppm, however, copper sulphate crystals induced chlorosis and limited the alga to 2 or 3 inches of growth.

Tribasic copper sulphate, applied at the rate of 10 ppm, had a more uniform and pronounced influence than the above.

Sodium arsenite was somewhat more effective than either of the copper compounds when applied at the rates of 3 and 6 ppm. Moreover, the influence of this chemical was noted well beyond the area of the test plots, apparently as a result of diffusion and mixing.

Hyamine, when applied at the rates of 2½ and 5 ppm, induced chlorosis and retardation of growth to an extent intermediate between the influence of copper compounds and sodium arsenite.

The influence of applications of Aqualin was apparent within 24 hours and strikingly obvious within seven days. Applied at the rate of 2.7 ppm, this chemical removed a very significant portion of the filamentous growth. An application of 5.3 ppm removed all but a few strands and 10.5 ppm produced complete destruction of the filamentous growth. The alga appeared to disintegrate *in situ* with no resultant shore-line accumulations.

Many fundamental facts pertaining to the growth of the alga with respect to the timing and duration of effectiveness of algicidal treatment are yet to be determined. The basic Canadian costs of treatment with Aqualin, its first and only application in this country being reported here, have not been calculated. Much more study is required. On the basis of limited observations, however, some useful conclusions may be drawn. The control of *Cladophora* growth in large bodies of water, involving a large dilution factor, may be difficult or impossible with traditional copper compounds. Sodium arsenite, with due regard for its general toxicity, and Hyamine may be applicable under some circumstances. Aqualin may prove to be exceedingly useful for the control of green algal production generally. Although it is still very much in the experimental stage, the rapidity and thoroughness of the action of Aqualin is most heartening and its apparent ability to bring about the breakdown and dispersal of the growth is of particular interest. Each of the other chemicals tested had a retarding influence upon the growth of the alga. Only Aqualin, however, brought about a complete removal of the filamentous growth which persisted for five weeks at least and until our weekly observations were discontinued.

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THE ACTION OF ARSENIC ON GERMINATION AND SEEDLING GROWTH

B. J. Rogers[1]

Inorganic herbicidal arsenicals are used in two forms —as the trivalent arsenite, and as the pentavalent arsenate. The action of the two differs greatly. Trivalent arsenic reacts with sulfhydryl groups (SH-groups) which occur in such biological compounds as cysteine, glutathione, and proteins which contain cysteine residues. The fact that arsenite reacts with cysteine and glutathione and various miscellaneous proteins is perhaps of little consequence in comparison with the reactions with certain highly important SH-containing enzymes. Impairment of the catalytic function of such enzymes can have far-reaching effects in cell metabolism.

On the other hand, arsenic in the form of the pentavalent arsenate chemically and physically resembles the phosphate group, which is essential in the conservation and transfer of bond energies. For instance, if we have glucose-1-phosphate and sucrose phosphorylase and fructose in a solution, we can produce sucrose. However, if arsenate is present, glucose-1-arsenate is produced and spontaneously hydrolyzes to glucose and arsenate, and no sucrose can be formed.

Corn seed was soaked in various concentrations of sodium arsenite and arsenate for 48 hours. The seeds were then rinsed in water several times, and placed in petri dishes in water to germinate. By measuring the subsequent root growth, and plotting the data in the form of a transformed dosage response curve, it is possible to demonstrate the difference in mode of action, and also the fact that in corn seed (Ind. 844D) arsenite is some ten times more toxic than arsenate.

The sensitivity of corn to arsenite and arsenate varies with the genetic composition. For instance, the cross WF9 x M14 is quite resistant to arsenate and also to arsenite, while one parent (M14) does not have the arsenate resistance, but does contain the resistance to arsenite. The inbred 38-11, on the other hand, has average sensitivity to arsenate, but would not germinate in the presence of 0.001 M arsenite. This variation in susceptibility probably resides in intracellular regions, but may be due to differences in uptake.

Root growth of turf grasses varies in response to the presence of calcium arsenate (0.5 lb/A). Crabgrass and Chewings fescue gave a greater response than did redtop, perennial and annual rye, or bluegrass.

From experiments with radioactive phosphate, it was shown that high arsenate concentrations (0.01 M) may reduce phosphate uptake by perennial rye seeds to one-third of that taken up by seeds in a control solution. Pre-soaking of seeds in an arsenate solution before germination also reduces subsequent phosphate uptake. Rye seedlings, treated in the same way, show a similar reduction in phosphate uptake in the presence of arsenate.

The action of the organic pentavalent arsenicals, such as DMA, is as yet unknown. They may act by interfering with phosphate metabolism, or they may be converted to the more active trivalent arsenic, as occurs in animals and bacteria. The fact that inorganic is often a contaminant in organic arsenical formulations has complicated their investigation.

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EFFECTS OF ENVIRONMENTAL FACTORS ON THISTLE SEED GERMINATION

Sam Zilke and Lyle A. Derscheid[1]

This is a further report on the life history of Canada thistle and perennial sowthistle. This paper deals largely with the effects of environmental factors on seed in the laboratory.

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The seed consisted of composite samples in order to minimize genetical and seasonal variations. Samples tested consisted of 4 replicates with 100 seeds in each. Seed was tested on blotting paper or in soil in plastic boxes 12 cm. square. Control chambers constant at 2-3 degrees C., 15°C., 20°C., 25°C., and 30°C. and chambers with alternating temperature of 15 and 30°C. and 20 and 30°C. were used.

The germination of untreated Canada thistle seed and perennial sowthistle seed on blotting paper at constant temperatures less than 25°C. was generally less than 5%. This could be used as a standard of comparison for various pretreatments of seed.

On blotting paper as a substrate two-year-old, 1-year-old, and fresh Canada thistle seed exposed to cold, 1° to 2°C. for a week germinated 89.0%, 25.0% and 14.0%, respectively, in 14 days at a constant 20°C. temperature. Two-year-old seed wetted and dried at room temperature over a period of 6 days germinated 63.7% at 20°C. in 14 days. Other pretreatments used before germinating at constant 20°C. were 30°C. for 2, 3, and 4, days, 35°C. for 3 and 4 days, light (100 watt Tungsten at 30 cm) plus 30°C. for 3 days, and cold 7 days followed by light 3 days. All of these treatments increased the germination of 2-year-old seed to 76 to 88%, with one-year-old and fresh seed giving less response. On the whole, the various pretreatments of the seed for germination at 20°C., except for the wetting and drying process, produced the same approximate results.

In experiments with untreated seed and blotting paper as a substrate in alternating temperature chambers two-year-old perennial sowthistle seed at 15°C. (16 hours) and 30°C. (8 hours) germinated 52.5% in 13 days, and two-year-old Canada thistle seed germinated 91.4%. At alternating temperatures of 20°C. (16 hours) and 30°C. (8 hours) the germination of Canada thistle seed in 10 days was 89.0%, 87.7%, and 45.0%, respectively, for 1957, 1958 and 1959 seed. Germination at continuous alternating temperatures produced approximately the same results as the various pretreatments followed by germination at a constant temperature of 20°C., especially with the older seed. However, recently harvested seed germinated best when pretreated with cold for 7 days followed by light for 3 days and then allowed to germinate at a constant 20°C.

In experiments with soil as a substrate, only tests with two-year-old seed of Canada thistle will be discussed. The moisture levels used were: 20% (field capacity), 10, 5, 25, and 15%. The germination tests were carried out in the same control chambers as above. Germination at constant temperatures less than 30°C. was low unless the seed had been pretreated. Germination of pretreated seed was similar to that on blotting paper. However, untreated seed in soil at the alternating temperatures, the 15° and 30°C. set was the more favorable. Wetting and drying of untreated seed in soil resulted in about 40% germination.

In order to determine what part of the seed was affected by the various pretreatments that resulted in germination at a constant 20°C. temperature or germination at continuous alternating temperatures, germination experiments with the seed coat cut and with excised embryos were carried out.

The seed coats of Canada thistle seed were cut in such a way as to expose the tips of the cotyledons, thus allowing moisture and air to enter freely. One set was kept at 20°C. and another at alternating 20 and 30°C. Within 6 days 1957 seed had germinated 59%, 1958 68%, and 1959 74%. Apparently, the younger the seed the more vigorous the germination. The mean growth in 21 days was 13.5 cm for 1957 seedlings, 23.9 cm for 1958, and 31.5 cm for 1959. At alternating temperatures of 20 and 30°C. germination within 6 days was 89, 82, and 82% for 1957, 1958, and 1959 seed, and the mean growth of seedlings in 21 days was 14.9 cm, 27.9 cm, and 28.8 cm, respectively. Thus, although the embryo will grow at 20°C. when oxygen and moisture are freely accessible, it will develop more rapidly at alternating temperatures.

Excised embryos of Canada thistle seed were grown at 20°C. Within 10 days 40% of 1956 embryos had developed; of two-year-old—84%; of one-year-old—76%; and of fresh material 88%. Within 7 days at alternating temperatures of 20° and 30°C. 72% of 1956, 88% of 1957, 96% of 1958, and 100% of the 1959 embryos had developed and grown. Thus, again, when the embryo has free access to air and water development is more rapid and more complete at alternating and higher temperatures.

One hundred 1959 Canada thistle seeds were cut and treated with 20 ppm gibberellic acid for 24 hours and then allowed to germinate at 20°C. The mean elongation of the 82 seedlings that developed within 14 days was 34.4 cm. Some preliminary tests showed that gibberellic acid will stimulate germination of uncut seed at 20°C. Thus it seems probable that gibberellic acid has the same effect on the embryo as the alternating temperatures of 20 and 30°C.

Thus it would seem that in the germination of Canada thistle seed, the sufficient stimulation of the embryo is an important part of the process. Apparently, if a physical factor or combination of factors can sufficiently stimulate the embryo the seed will germinate.

[1] Graduate Assistant and Associate Agronomist, respectively, South Dakota State College. Research done in collaboration with N. C. Regional Project 10, Subproject 3.

THE EFFECT OF TRIRHABDA PILOSA, A LEAF FEEDING BEETLE, ON BIG SAGEBRUSH IN BRITISH COLUMBIA

W. L. Pringle[1]

The paper as presented was a pictorial record of the invasion and depredation of *Trirhabda pilosa* over a four-year period on the sage invaded ranges near Kamloops. In 1954 a Chrysomelid beetle, *Trirhabda pilosa* Blake, was discovered to be infesting big sagebrush on ranges near Kamloops, B. C. So severe were its depredations that in three years it had spread out from a small patch to cover some 4,000 acres of rangeland on both sides of the Thompson River. The insect, which overwinters as an egg, has one life cycle a year. Larvae, which are active during June, perform the majority of the damage. Mature insects, which emerge during July, are also capable of severe defoliation. This beetle is host specific to big sagebrush. Only big sage which has previously invaded abandoned dry farms and grassland range is seriously affected. Under such conditions records have shown that up to 50% of the mature plants may be killed out in one season. On such range volume of forage may be more than doubled by reduction of the weed shrub.

During the study it was found that sage used as aphid pasture by ants was protected from invasion by the beetle and so survived to stand out like flags in an otherwise defoliated stand. Attempts at moving beetles to other sage invaded ranges have so far been unsuccessful. The insect is taxonomically native to the area. On the weedy sage stands where it has done such damage it has undoubtedly found conditions more suitable for its survival and reproduction, thus its population has "exploded," creating this startling and economically desirable result over its host plant.

Recent observations have shown that many injured plants regain vigor after the insect wave has passed through and young plants are not as severely damaged as mature ones. Because of these facts any economic advantage which could be derived from this biological control method would only be sustained if coupled with proper range management.

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A COMPARATIVE STUDY OF THE EFFECTS OF TCA AND DALAPON ON FLAX

R. C. Henne and G. Friesen[1]

The use of TCA since 1952 in the control of annual grass weeds such as green foxtail in flax has been of great help to Manitoba farmers. Similar control of weeds has been obtained by a closely related chemical, dalapon, which is a more efficient and economical herbicide. Dalapon at present is recommended as an alternative to TCA for green foxtail control in flax in several areas, but because of lack of information on its effects under Manitoba conditions, it is only recommended on a 'trial use' basis here. Therefore in 1958 and 1959 the University of Manitoba made a study of these two herbicides to determine their effect on morphology, yield and seed quality of three commercial flax varieties.

TCA was applied at 4 and 8 lb/A and dalapon at 1 and 3 lb/A to three flax varieties—Redwood, Raja and Marine—grown under weed-free conditions. Treatments were made at two dates: (1) when the flax was 2 to 3 inches tall or had developed from 4 to 6 true leaves, (2) when the flax had reached the early bud stage. Both herbicides were applied in 90 gallons of water per acre.

In 1958 separate experiments were used for each herbicide. The experiments consisted of a split-plot design with five replicates, varieties being the main plots and rates of treatment the sub-plots. In 1959 one large experiment, a modified split-plot design with six replicates, was used for both herbicides. In both years individual plots were 4' x 18½' in size, with eight rows of flax. The center four rows of each plot were harvested.

1. Effect on morphology. In 1958 the TCA treatments of 4 and 8 lb/A had no visible effect on the flax plants while in 1959 the higher rate caused slight stunting. The 1 lb/A rate of dalapon showed signs of slight leaf tip burn in 1959 only, while on the other hand the 3 lb/A rate showed severe damage to the flax in both years. The abnormalities evident were stunting of the plants, leaf tip burn, and delayed maturity. Deformities at flowering time were also evident in both years. The flower petals in the plots treated with 3 lb of dalapon remained tightly curled compared to normal opening of flax petals in untreated plots. The bolls in treated plants contained immature seeds which failed to develop, resulting in extremely low yields.

2. Effect on yield. In 1958 TCA at the 4 lb/A rate had no effect on yield, while the 8 lb/A rate affected the variety Marine. Dalapon at the 1 lb/A rate appeared to be fairly satisfactory, while the 3 lb/A rate caused severe yield reductions in all three varieties.

The yields for 1959 show that both TCA and dalapon caused yield reductions. The 4 lb/A rate of TCA reduced yields by approximately 3 to 4 bu/A while the 1 lb/A rate of dalapon caused a 6 to 10 bu/A reduction. The 3 lb/A rate of dalapon was disastrous to the yield of flax.

3. Effect on oil content and oil quality. In 1958 TCA at 4 and 8 lb/A had no effect on the oil content or oil quality of the flax seed. The 1 lb/A rate of dalapon in 1958 did not affect the oil content or quality, but the 3 lb/A rate reduced both these factors in all three varieties. The seed quality tests for 1959 have not been completed to date.

It would appear from the above observations that TCA is the safer of the two chemicals to use on Manitoba flax varieties. Dalapon used at ¾ lb/A would probably give good results in most years if the farmers are careful in measuring the concentration of the chemical, in calibrating their sprayers and not overlapping when spraying. It is also recommended that farmers be cautioned that damage to a flax crop may occur if dalapon is used.

[1] The University of Manitoba, Winnipeg

PERSISTENT PERENNIAL WEED CONTROL IN SASKATCHEWAN

T. V. Beck[1]

Persistent perennials have long been present in Saskatchewan. First reports of hoary cress came in 1896. Leafy spurge was first reported in 1927. Active control began in 1928 on Russian knapweed and 1931 on leafy spurge. In 1944 there was a renewed interest in the problem when the Department of Agriculture purchased a large quantity of chemical and two sprayers. Chemical was sold to municipalities at cost and the machine and operator was rented to municipalities on an hourly basis. This program continued until 1948.

A weed control representative was appointed in 1948 to organize the program. A survey made at that time revealed the following acreages: leafy spurge, 1,750; hoary cress, 450; Russian knapweed, 275; field bindweed, 1,750. Two large infestations of toadflax were estimated at over 3,000 acres.

In 1949 the Canada Department of Agriculture financed a survey conducted by the Plant Ecology Department, University of Saskatchewan. Continued for seven years, it covered about one-third of the province and mapped the following acreages: leafy spurge, 9,634; toadflax, 142,700; hoary cress, 1,754; Russian knapweed, 1,960; field bindweed, 11,096. Re-surveys in many municipalities showed that often the weeds were increasing despite control measures.

In 1949 impetus was given to the program by the introduction of the "Earned Assistance Policy". Under this policy the Department of Agriculture paid half the cost of controlling leafy spurge, hoary cress, toadflax, Russian knapweed and bladder campion. Cost to the department from 1949 to 1958 was $429,748.00. Half the cost of a high pressure sprayer, to a maximum of $400.00 was made refundable to each municipality. A total of 169 sprayers have been purchased at a cost of $59,568.00 to the department.

To assure efficient use of the funds and more adequate control, a policy was adopted in 1953 to allow six or more municipalities to unite to hire a district weed supervisor. Half the cost of his wages and travelling expenses to a maximum of $300.00 per municipality is paid by the department. Eleven units, covering one-third of the province, have been formed. Cost to the department is about $7,000.00 per year. This policy has probably given more returns per dollar spent than any other.

(a) Monuron, chlorate-borate (Polybor-chlorate), and sodium chlorate mixtures (Atlacide and Erocide) have all been used in the program, and the latter (Atlacide) is still being recommended for the control of hoary cress and for the control of Russian knapweed on heavy soils. However, anhydrous borax (Concentrated Borascu) is the main chemical used at present because of its lower cost. Though its action is slow, the results are very satisfactory, particularly on toadflax. It was slow to be accepted because of its dry application, but this is now considered to be a distinct advantage.

Since 1944, 4,621,000 pounds of chlorate and chlorate-borate mixtures, 1,078,000 pounds of anhydrous borax and almost 26,000 pounds of monuron have been distributed. This is sufficient chemical to treat almost 4,000 acres at recommended rates.

In 1950, the Canada Department of Agriculture established a special illustration station to study toadflax control. Research at the station has shown:

(a) There is little advantage in two consecutive years of summerfallow.
(b) Seeding the land to grass will hold the weed in check.
(c) Cropping, with fall tillage of stubble, followed by intensive summerfallow will almost eliminate toadflax in four years.

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(d) Tillage operations on summerfallow may be reduced to seven or eight from the ten to twelve originally thought necessary.

Because of these findings more stress is being placed on cultural control of all persistent perennials. Financial assistance is given by the department for cultivation where the land is directly controlled by the municipality. Where grass is used, the cost of grass seed and half the cost of 2,4-D applied are paid by the department.

To determine the effectiveness of the program, questionnaires were circulated in 1956 to responsible local officials. A summary of opinions were as follows:

(a) The weeds were not increasing substantially where a good control program is being conducted, except where the program was not started soon enough.

(b) No farms have been abandoned to them and it appears that the situation is not as serious as originally thought.

(c) In places we are going to have to "live with" these weeds, but we must strive for control in all areas, and eradication wherever possible.

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METHODS OF CONTROLLING CANADA THISTLE

Lyle A. Derscheid[1]

Large infestations of Canada thistle can be controlled by intensive cultivation, certain competitive crops, herbicides, or combinations of cultivation, crops, and chemicals. Numerous non-selective herbicides can be used on large infestations, but are generally too expensive to be economically feasible.

Intensive Cultivation

Intensive cultivation from spring until freeze-up will kill a high percentage of the thistles. Cultivation from immediately after harvest one year until freeze-up the next is more effective.

A duckfoot field cultivator or a one-way disk are equally satisfactory implements. However, it is frequently desirable to plow first if there is considerable residue. Equip the duckfoot cultivator with wide sweeps (12 to 24 inches) that overlap 3 to 4 inches. Keep them sharp and see that they are flat when in the soil and operating at a depth of 4 or 5 inches. Likewise for the one-way disk—keep the disks sharp and operate at 4 to 5 inches. It is essential to cut each thistle root at each cultivation.

It takes 10 to 15 days for the plants to emerge after the roots have been cut. Another 10 to 15 days elapse before there are enough leaves to produce more food than is needed for growth. Therefore, little food is stored in the roots for a period of 20 to 30 days. Cultivate every 3 weeks during good growing conditions and every 4 weeks during periods of dry, hot weather when the plants are growing less rapidly.

A disk harrow is also a satisfactory implement, when preceded by plowing. Experiments have shown that double disking with a tandem disk was satisfactory when used every 2 weeks.

Combining intensive cultivation for part of the season with the production of a crop and a chemical application is generally more practical than an entire season of cultivation. Income from the crop is obtained and the hazards of erosion, resulting from a full season of cultivation, are greatly reduced.

Spraying

There are several herbicides that can be used. 2,4-D is cheaper than 2,4,5-T or MCPA and is equally effective on the weeds.

Use ⅓ to ½ lb/A of 2,4-D or MCPA to kill seedlings, prevent seed production on mature plants, kill some old plants, and weaken others so that later treatments kill them. Treat when the weeds are in the rosette stage (either spring or fall). Two treatments in 1 year (spring and fall rosettes) will kill up to 85% of the thistles. Usually thistles that are not killed by two treatments the first year are more resistant to the chemical and cannot be killed by spraying. Some other treatment, such as cultivation, is needed to eliminate them.

Amitrol generally kills over 90% of Canada thistles. Apply at 4 to 6 lb/A in 10 to 30 gallons of water when the thistles are starting to bud. Similar treatments made to thistles 6 to 8 inches tall generally give good top kill but very little root kill. Excellent results are sometimes obtained by treating regrowth of thistles that have been mowed or plowed. Treat with 4 to 6 lb/A after regrowth is 8 inches tall and before buds start.

Cultivation, Crops, Chemicals

Small grains. A high percentage of thistles can be eliminated in a year when small grain is being produced. Barley and wheat are generally more tolerant to 2,4-D than oats, and are usually used. Spray the grain with ½ to ¾ lb/A of 2,4-D amine or MCPA amine when the thistles are not over 6 inches tall and the grain is in the 5- to 6-leaf stage. This will prevent the production of seed and weaken the plants. Follow-up treatments after harvest will deliver the knock-out punch. Experiments indicate that the percentage of thistles killed will depend on the follow-up treatment used.

(1) Three cultivations after harvest (one plowing and two cultivations with duckfoot cultivator or one-way disk) killed 85% of the weeds the first year. Repeating the spraying and three cultivations a second year gave 100% elimination.

(2) Plowing after harvest and spraying with ¾ lb/A 2,4-D or MCPA after thistles emerged on the plowing killed 85% of them in 1 year. A second year of this complete treatment (spray-plow-spray) gave 98% elimination.

(3) Spraying in the stubble after harvest gave 50% kill. Three years of spraying in the grain and again after harvest gave over 90% elimination.

(4) Late fall plowing (late October) gave 70% kill in 3 years when used as the only fall treatment after spraying in the grain each year. However, it did not improve results when any of the other fall treatments listed were used.

One application of 2,4-D or MCPA in corn kills very few thistles. However, two applications of ½ to ¾ lb/A (once before the second cultivation and once after tasseling, with drop nozzles) can be expected to kill about 40% of the weeds.

Forage crops. A good crop of alfalfa or alfalfa-bromegrass mixture, which is cut regularly for hay, almost eliminates thistles in 3 years. The use of 4-(2,4-DB) may control annual broad-leaved weeds and Canada thistle the first year when establishing the stand.

A good crop of bromegrass which is cut regularly for hay will generally give over 90% elimination in 3 years. Spraying with 2,4-D twice a year (early June and mid-August) in a good stand of bromegrass, crested wheatgrass, or other strongly competitive perennial grass will generally kill over 90% of the thistles in 3 years. Use ¾ lb/A of 2,4-D, except use only one-half pound the spring that the grass is seeded.

Elimination of thistles can be achieved in less time by intensively cultivating the infested area five times prior to the seeding of a forage crop in mid-August. About 90% elimination can be obtained the first year

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and 95% the second year. However, the use of 2,4-D in grasses the second year will generally give 100% elimination by the end of the second year.

Fallow. Where a 3- or 4-year rotation includes a fallow year, several treatments can be used during that year, to reduce the stand of thistles. A spring tillage operation followed with 1 lb/A 2,4-D, 2 lb/A of 4-(2,4-DB) or 3 lb/A of amitrol when the weeds are in the bud stage with cultivations resumed 6 weeks later eliminated a high percentage of thistles. A spring cultivation followed with ½ to ¾ lb/A of 2,4-D at budding and again 2 weeks later, followed with a final cultivation at freezeup, was equally effective.

Soil Sterilants

Numerous soil sterilants can be used to eliminate patches of thistles with one treatment. Most of the chemicals give best results when applied between September 1 and December 1; however, good results are often obtained from summer applications. Apply the chemical to a band 6 or 8 feet wide around the outside of the patch to kill roots that extend beyond the patch.

The following sterilants (all trademarked commercial products except the last) are generally effective in giving at least 95% elimination when applied at the rates designated for each square rod. The lower rates are satisfactory for fall treatments, but the higher rates are sometimes needed for summer applications.

	Rate per sq rod, pounds
Ammate X (ammonium sulfamate)	4 to 6
Atlacide (60% sodium chlorate)	6 to 8
Baron (erbon)	½ to 1
Chlorax (40% sodium chlorate, 58% borax)	10 to 12
Chlorea (40% sodium chlorate, 57% borax, 1% monuron)	6 to 8
Concentrated Borascu (sodium borate ore, 61.5% boron trioxide)	12 to 15
DB Granular (7.5% 2,4-D, 39.2% boron trioxide)	5 to 6
Polybor-chlorate (25% sodium chlorate, 49% boron trioxide)	10 to 12
Sodium chlorate	5 to 6

Control Seed Production

Since thistle seeds can be carried many miles by wind and water, it is imperative that thistles be prevented from producing seed. A high percentage of the seeds will germinate in thistle heads that have been open 8 to 10 days. Viable seeds will not be produced if the plants are mowed during the week they bloom or earlier. Likewise, spraying with one-third to one-half pound of an ester of 2,4-D will generally prevent the production of viable seed if the flowers have not been open more than 4 days at the time of spraying.

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WILD OATS CONTROL

Lars Jensen[1]

Wild oats is the most serious annual weed in North Dakota. Every North Dakota farmer knows wild oats. There are four main reasons why wild oats are so prevalent:

1. Wild oats mature ahead of small grain and row crops shattering seed ahead of harvest. Five to twenty bushels of shattered wild oats seed is not uncommon.

2. New crop seed has a high percentage of dormancy which allows seed to accumulate in the soil from year to year.

3. Seeds can remain viable even when buried in the soil for several years. This allows further accumulation of seed.

4. There is no selective chemical available for general control in small grain and row crops except sugar beets.

Wild oats control must be based on cultural practices. This involves getting the seed to sprout and destroying the plants before they reseed. As all farmers know this is not easy. Several facts about the behavior of wild oats help in establishing satisfactory cultural control methods. The dormancy of new crop seed may vary considerably but can extend from about a month after maturity until the following spring and even then some seeds may still be dormant. Nature can help us break this dormancy by exposing the seed to alternate wetting and drying and freezing and thawing. This suggests that there should be no after-harvest tillage in the fall. Early spring tillage is the preferred date although late fall tillage can be used as an alternative to cover seeds and promote early spring germination.

Wild oats seeds rarely germinate during the summer from late June through August. This means that regular summerfallow is not an effective practice. Fall germination, too, is usually poor and undependable even though moisture conditions seem favorable. Spring is the best season for wild oats germination and every effort must be made to germinate and kill as many crops as possible before mid-June. Wild oats seedlings are not easily killed by spring cultivation especially if they are too small. Better kills are obtained when the wild oats seedlings are three to four inches tall than earlier.

Burning stubble with a heavy population of wild oats seed shattered and lying on top of the ground is of very little help. Apparently the burning does not break dormancy nor kill the seed. The organic matter saved by not burning is worth more than any wild oat control obtained.

Deep plowing only serves to scatter the seed through the entire plow layer. Those seeds buried deeply may lie dormant for a number of years and may be brought up closer to the surface by future cultivations where they will germinate. In general, wild oat-infested land should be worked shallow to keep the seeds relatively near the surface for more reliable germination.

Sowing a field down to grass or legume is generally not satisfactory. Moisture conditions under sod are generally not favorable for either seed rot or seed germination. Some wild oats seeds will remain viable even though the field is seeded to grass or legume in a long rotation. Short rotations only seem to serve to break the dormancy so the first crop after sod is quite heavily infected with wild oats. Probably the best practice is to follow such crops with either delayed planting or fallow.

Wild oats seeds can survive animal digestion. It is not a good practice to feed whole grain or hay containing wild oat seed. If the crop is put up as silage or the manure allowed to heat then germination of the wild oat kernels is destroyed.

The following control practices are suggested based on the above wild oat control facts and farmer experience.

Small grains vary in their ability to compete with wild oats. Barley is the best competitor, wheat is second, oats third and flax the poorest. The best choice of crop to plant on a field containing wild oats seed that must be planted early is barley.

A rod-weeder or harrow can be used successfully for wild oat control just after the seeded grain crop has sprouted but before emergence. Post-emergence harrowing operations are very practical in corn and soybeans and are successful to a lesser degree in wheat and barley. It is generally felt that surface conditions must be dry and that the wild oat seedlings should be small (with less than two leaves) for this practice to be successful. If these after-seeding cultivations fail, then the best practice is to sacrifice the crop.

Starter fertilizer applied in the row with a grain drill

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attachment gives the crop a better chance to compete with wild oats. This early advantage for the crop is often enough to crowd out considerable wild oats.

Fall rye seeded on summerfallow gives excellent control and is a practice that can be used on seriously-affected fields.

Delayed seeding is very effective and probably the most commonly used practice. It is based on the fact that little or no wild oats germination occurs after early June. Crops such as flax, corn, soybeans and millet are commonly used. This delayed seeding, however, does require a sacrifice in crop yields. Delayed seeding is an excellent practice to use in rotation especially on the worst fields.

When all other practices fail it may be necessary to work up a badly-infected crop and reseed it or to cut the crop early for hay or silage. If the crop is taken for hay it should be cut when heading begins because some seeds may be viable four to six days after heading.

Operators can use the above suggestions to work out satisfactorv cropping and rotation plans for wild oats control. With the use of 2,4-D, MCP, dalapon, and TCA certain changes in rotation practices may be possible, especially for flax growers. Flax can now be grown successfully on weedy land and the early summerfallow can be placed in a better position in the rotation for more effective wild oat control.

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HOW CAN EXTENSION AND REGULATORY AGENCIES WORK BETTER WITH INDUSTRY TO HELP THE FARMER?

M. B. Turner[1]

To understand the problem in which Extension, Regulatory, and Industry have a common interest let us for a moment review a few developments of the last fifteen years. Everyone will agree, I am sure, that prior to World War II farming was a different sort of business than it is today. For one thing, it was a harder job. There was more back-breaking labor involved to produce a bushel of grain or corn, or a hundred pounds of butterfat or beef. And the farmer spent more hours at this heavy work. There were fewer things that a farmer could do fifteen years ago to step up yields of his crops, put more weight on his animals, or increase milk production. Reason? The tools were not available to him. He didn't have the machines, the chemicals, and the medicines that Industry has provided since the end of World War II. We can agree therefore, I think, that farming today is indeed a different business than it was only a few short years ago. And it is probably not particularly important that we try to apportion credit for the change to this segment or that segment of industry . . . like saying 15% belongs to fertilizers, 20% to improved farm machinery, etc . . . rather let us say the change is the end product of all the many factors combined, and each is dependent upon the other. In the interest of developing the specific subject of this paper, I want to confine my considerations to pesticides, and more particularly, to herbicides.

Fifteen years ago we certainly didn't have a very impressive array of weedkillers to work with. From memory, we had to rely on such simple compositions as sodium chlorate, borax, sodium arsenite, and probably one or two other inorganic compounds. We said they were weedkillers. They were weedkillers, I guess, if you class any growing plant is a weed. My point is that where they were used, they were used for the most part to kill all vegetation. True, you could introduce "selectivity" by changing dosage rates, but by and large the original, simple, inorganic compounds were used for total vegetation control which involved using massive amounts on a small area.

Two organic materials had made their appearance before World War II. I am thinking of ammonium sulfamate and the nitro-substituted phenols. The nitrophenols were actually the start of our present day philosophy on weedkillers, in that they were the first to be put to work for selective weeding of farm crops. And I might say, at this point, that despite all the advancement in technology on herbicides, none of these older materials have disappeared from the scene. Rather, my guess is that they continue to be used in ever increasing quantity and there is no doubt but that, in their place, they render a very valuable service.

Today, 2,4-D is king among weedkiller chemicals throughout the world. In the beginning, 1946 or thereabouts, the wonders told about this chemical for the first time were so amazing as to defy belief. Who ever heard of spraying a wheat field, yellow with mustard, using only a cupful or two of liquid weedkiller, mixed with water, and having the mustard literally disappear before your very eyes? And all of this with no damage to the wheat. Sounds preposterous. As a matter of fact, it well did in the very beginning. But all of us here today know that is was no sleight of hand being witnessed in those early day trials and demonstrations. You might say we were looking at a miracle born in the test tubes of the chemist being put to work at the job for which it was suited . . . that of killing weeds, or more specifically, killing certain kinds of weeds out of some of the principal crops we rely on for our food supply.

Acceptance and utilization of 2,4-D was slow in the early days for reason that it was so spectacular. The farmer I believe still looks upon all agricultural chemicals with a certain awe or wonderment. To him there is an aura of mystery about them. Yet, despite this, 2,4-D has grown and diversified in usage, and today it is king. If I were to register any complaint about 2,4-D usage today, it would be that it is being called on to do jobs for which it is not well suited. I think we have come to expect too much of it, or rather the farmer has come to expect too much of it. We need to remedy this situation.

The farmer's gradual acceptance and utilization of 2,4-D, just like his gradual acceptance and utilization of DDT, had its impact on the chemical manufacturing industry. I think it also had its impact on the research people in the college and the USDA Experiment Stations throughout the nation. I am certain there has been a growing awareness of weeds and what they cost the farmer in one way or another. There has been a rush over the last 8 to 10 years on the part of Industry to come up with new chemicals which would solve particular weed problems. We are learning the faults, or rather the deficiencies, the limitations, of 2,4-D. There are more research men in the colleges and in USDA working on specific weed problems than ever before and every effort is being made to categorize new weedkiller chemicals based on the specific job they do. The present day list of weedkillers is fairly long, and each new one that comes along seems to be more complex in its chemical construction, more specialized in what it will do, and more limited in the way it must be used. Yet there can be little doubt but what any of these new chemicals, when used as directed for the specific purposes named, does bring benefit to the farmer, and by benefit, I mean greater efficiency in and increased earnings from his farming operation.

Now, it would seem the only job remaining to be done is to get the information to the farmer and to get it to him in a way which he will understand. This job, perforce, belongs to the Extension and Regulatory agencies working with Industry.

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Let us look at what Industry does to generate interest in new weed-killer chemicals they develop.

First of all, it is understood I am sure that development of the new chemical does not take place with a manufacturer working alone. The manufacturer does synthesize the new chemical. He screens it to determine where it has biological activity. He has his own yardstick by which he measures activity so as to know whether to proceed with the compound or discard it. Those that pass the tests of primary screening are subjected to further tests, more rigorous testing you might say, to measure properties of the chemical. In all of this testing work, standards which the new chemical must attain are obviously very high.

Should a new chemical survive this secondary screening, the manufacturer then enters into a joint evaluation with the research men in the colleges and in the Federal stations. Finally, if luck is with you, a new chemical, having commercial potential is spawned. Labelling requirements of the Federal Government or of the States might very possibly thwart the development at this stage, but let us presume the manufacturer gets by this hurdle. He is now ready to announce his discovery, to tell his story on his new weedkiller to the customer . . . the farmer. And how does he do this?

His label, frst of all, must be complete and fairly comprehensive. His literature must conform to the label. His advertising must tell the story in order to generate interest; yet his advertising must not mislead. So let us say all of these things are done. Remember, the customer is the farmer. The farmer does not know the manufacturer. The manufacturer, industry if you will, just cannot establish communication with the farmer because of the magnitude of the job alone. Industry can and does try to educate and try to disseminate information through its jobbers, or distributors, and on down the line through retailers who live in the farm community. But remember these people are, first of all, business men, capable enough in business matters, but not students of science and probably are incapable, generally speaking, to grasp the subject matter so essential to proper use of the chemical. Where then can Industry look for understanding of what it has developed and for education and dissemination of information to the farmer? The Extension and Regulatory agencies are the obvious choice. You may ask, "Is it not true that the County Agent already has more than he can handle without becoming an expert in weed control?" The answer has to be "Yes." I doubt that it is possible for the average man to be expert in all of the fields of science with which the farmer has to deal in the everyday business of farming. Matter of fact, I somehow doubt such achievement would be possible even for the most capable of men.

But, I submit that the business of weed control is not such an appalling subject if we, first of all, deal with it in small enough units. For instance, if you analyze the makeup of agriculture on a county-wide basis, is it not true that within the county the pattern is fairly simple? Isn't it true that you would probably find not over six or seven different crops grown within the county? Is it not true, also, that you would probably find only three or four noxious weeds or hard-to-kill perennial weeds that amount to anything within the county? Wouldn't the County Agent be well informed and couldn't he render a very valuable service were he to learn all the details of weed control as it related to the particular crops in his county, and to learn, also, all the particulars available for the control of the hard-to-kill perennials found in his county? This latter information, maybe all of it for that matter, would be of equal value to the Regulatory man in the county. And yet this particular knowledge would probably account for only a small portion of the total knowledge on weed control the state over, or let us say within the area embraced by the North Central Weed Control Conference. What I am trying to point up is that there is little value in being expert on the broad subject of weed control when chances are you will have need for only a small segment of this knowledge; yet there is great need to know all you can about weed control as it affects you in your particular area. Industry can help in the organization and assembly of this information, just as the college in your State or Province can help. It is largely a matter of organization of information that is already available, but it seems to me that in order to know what information should be put together for any given area, section, county, etc., the County Agent or the Regulatory man in the County should have knowledge of his particular crop situation, his particular weed problems, etc., then ask for the program to fit his needs, and finally, make it his business to develop an understanding of the program.

"Farmer-dealer" meetings are nothing new. They have been carried on, within my memory, for at least ten years and probably longer. Many times the State Extension Weed Specialist is the key man at the meeting. Other times, an Industry representative does the talking and showing of slides, etc. There are a few times when the County Agent or the County Regulatory man will conduct such meetings, or in even rarer instances, you find some farm chemical dealer holding such a meeting. It seems to me all of these meetings actually ought to be called and be conducted by the local County Agent, or the local County Agent working in cooperation with the county Regulatory man. I suspect that if this thing ever got underway on a large scale, you would find an ever increasing number of farm chemical dealers attending, and gradually they would want to sponsor meetings themselves to discuss newer developments in weed control and to keep alive their personal interest, which I feel is bound to develop.

And why is it that more of this sort of thing doesn't go on every year? First of all, probably because there is no busier person in the farm community than the County Agent or the Regulatory man, but of equal importance I believe is the general lack of understanding of the whole business of using chemicals for weed control. There is still something of the mysterious about chemicals, something that is hard to put your finger on. It is a little hard to develop the same sort of feel for chemicals as the average person does for a plow or a tractor, or other farm tool. Yet, chemicals on the farm are as much of a tool as any farm implement, and they will be more extensively used the more the farmer understands them and learns how to use them.

Let met summarize as follows. Pesticides in general, and more particularly herbicides, have grown to important stature in present day farming methods within the short span of the last fifteen years. The number, the complexity, and the utility of herbicides has increased throughout this time. Herbicides are the invention, first of all, of the chemist who enlists the aid of specialists in other scientific fields to evaluate and develop their utility. All of this goes on with the one objective in mind, to create a tool which will sell to the farmer. Yet the farmer, to become a customer, must understand the tool and must be able to visualize the gains that accrue to him through its use. Industry needs the help and cooperation of the Regulatory and Extension agencies to educate and to disseminate information on these new chemical tools. There needs, first of all, be an awareness of the weed problems and the cropping pattern or the general pattern of agriculture within the county, then there needs to be an understanding of what I call a "feel" for the utilization of these chemical herbicides so that they can be put to work by the farmer to perform the maximum benefits inherent in them. I have made certain suggestions, undoubtedly there are others. Of one thing you can be certain and that is, full cooperation from the Industry in getting the job done.

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PANEL DISCUSSION: DEALER EDUCATION—HOW BEST ACCOMPLISHED

Moderator: E. P. Sylwester

A REGULATORY VIEWPOINT

William Lobay[1]

The question of dealer education is a very important one. A dealer can introduce a herbicide which really will fit into a local weed problem and contribute much towards weed control, or he can be responsible for improper use of a good chemical and thereby virtually eliminate such a herbicide for use in a locality. In the Province of Alberta the lack of knowledge by some dealers about proper chemical use was partially responsible for the county and municipal agricultural groups (Agricultural Service Boards) purchasing and distributing directly to farmers the proper herbicide for the proper crop and weed.

A good dealer in herbicides is an essential person in a community and a necessary link in the local weed control program. Today weed control and herbicides are nearly synonymous terms. Man's nature is such that he will generally resort to cure rather than prevention, and in that respect the farmer looks towards herbicides as a cure for his weeds. The prescription that he gets must be right or else it will not accomplish the job and indeed may do harm. If the dealer is to make this prescription he must have a wide knowledge of the material, the know-how of its action and reaction, and be fully aware of its side effects. Herein lies the importance of knowledge that the dealer must have!

The company or the manufacturer which is looking for dealers to handle herbicides should have some responsibility in selecting personalities which have the welfare of the farmers and the district at heart. A dealer with a practical farm background would be an asset. He should have the ability and the willingness to learn and become familiar with his product and to know the needs of his district. Although this item is not "dealer education" proper, we might consider it as a prerequisite.

Having selected suitable material as dealers, the next step would logically be their training. Every large company puts out various leaflets and booklets praising its own product and I don't believe we have any quarrel with that. However, such material is often not read, or perhaps not too well understood by the dealer, or does not provide some basic fundamental understanding resulting in the dealer operating with some misconceptions or on hearsay. This to a large degree, I think, can be remedied by the trade conducting schools for dealers. An informal school would have the advantage over the individual contact (which must not be minimized) in that it would bring the dealers together, giving them the opportunity to share mutual problems In Alberta, a large seed cleaning firm is presently conducting schools for seed cleaning operators in the proper use of machinery Why couldn't the same be done with weed chemicals? Every large weed chemical firm has some very capable men who could offer a first-class course in basic fundamental concepts of herbicides, in elementary language. If this is now done, perhaps it should be more widely expanded

Realizing that a well-trained dealer is an important asset to the regulatory and extension weed worker, local agricultural authorities might also consider the merit of conducting dealer schools In Alberta plans are under way in at least two counties to conduct such schools this spring.

Another way to keep the dealer informed is to provide him with publications which give information in simple form on control of specific weeds. Such publications should be clear, concise, up to the point, and written in simple language. A table in a leaflet can often tell the story but one must make sure the dealer is interpreting it properly. Those of us who are associated daily with weed chemicals might take too many things for granted. To a dealer the explanation of every detail is a very important matter. I know of a dealer who stated he was getting lost in the extensive lists of herbicides coming out yearly. Listing them alphabetically I could see his point. However, if someone grouped them as to their purpose there aren't really that many. We have sterilants and non-sterilants—this is one division. In the non-sterilant group, we have (1) selective herbicides — those for controlling broad-leaved weeds in crops, and (2) herbicides for removing grass-type plants (quackgrass). And then what else have we got? Certainly within each group there are many which differ in some respects, but after some basic understanding and with proper training the dealer would soon have this realization. Simplicity and the proper sorting is the keynote here, and publications and training must strive towards that goal.

Finally, I want to make this comment. The dealer must know what are the really significant local weed problems and what crops are generally grown in his area. He should be instructed to discuss this with his agricultural representative or county agent to help him determine what he really needs to supply the public in the weed control field.

These then are a few points which I feel should be considered towards accomplishing dealer education.

I would like at this time to express our appreciation to all chemical concerns which have worked so closely with us and helped us with our weed control program.

[1] Supervisor, Soils & Weed Control, Alberta Department of Agriculture, Edmonton, Alberta.

AN INDUSTRY VIEWPOINT

W. J. McCoy[1]

Because farmers consult their local dealer more frequently than anyone else regarding their agricultural chemical needs, the dealer has become a vital force in selling chemical weed control to his farmer customer. The State Agricultural College system—through the Agricultural Extension Service—is the basic source of information on how to use agricultural chemicals properly. Various farm publications, radio, television, farm meetings, and other informational media succeed in arousing the interest of farmers and making them more aware of better chemical weed control practices. However, when an individual farmer prepares to make his decision on what course he will take, he likes to "talk it over" with someone in whom he has confidence. For his herbicide facts, he turns most frequently to the local dealer and the local professional agricultural worker —the county agent, SCS specialist, or Vo-Ag teacher.

Most of the discussions between the dealer and the farmer take place when the farmer is actually making his chemical purchase. This places the dealer in a key position to influence the kinds and amounts of herbicide the farmer actually buys. Therefore, the importance of the dealer as a source of agricultural chemical information is due not only to his frequent contacts with his customers but also to the stage in the decision-making process when he exerts his influence. The dealer's approach at the time the farmer is deciding what to buy has more impact that earlier educational contacts—before the farmer is actually making his decision.

The problem is to make sure that agricultural chemical dealers not only have the information they need, but know how to use it. This is properly a responsibility of the agricultural extension service in cooperation with the local agricultural chemical industry. In most states, the agricultural extension service has as-

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sumed its share of the responsibility, and is carrying on dealer education activities.

These educational activities usually center about an annual meeting or series of meetings or schools. Unfortunately, this approach has not met with uniform success. One problem has been attendance. Frequently, those who need help the most are the ones who don't come to the meetings. Another vexing problem has been the apparent lack of response by many of those who do attend. Perhaps this comment by a Midwest dealer—and echoed by dealers everywhere—is a key: "Meetings are planned, not to meet our problems, but to give us information which someone else thinks we need." This suggests that to be successful, a dealer education program must deal with those subjects that are of real and basic interest to the dealer. What dealers want to know is how to sell chemicals and make money doing it. The kind of information he wants and needs is that which will help him become a better businessman.

A subject of keen interest at dealer meetings is the evaluation of experimental data from an economic viewpoint. Dealers prefer to have research results boiled down to practical terms. The mere presentation of information about research alone is not enough, and seldom stimulates interest or action on the part of dealers. Dealers want to know how research results can be applied, and what it means in dollars and cents to their farmer-customers and themselves. How much do Canada thistles, quackgrass, foxtail, wild buckwheat and many other troublesome weeds reduce crop yields and what return can be realized from applying an approved chemical in increased yields, time saved, etc.?

Educational objectives should be clear cut. Some of the older chemicals (i.e. 2,4-D) are offered in various formulations. We still have a long way to go before a majority of the farmers are using a profitable chemical weed control practice. Therefore, our primary objective should be to educate toward increased usage of a profitable approved practice. Education on formulations to use is secondary.

Spray suggestion letters during the season have been used very successfully to keep dealers informed of new products and/or uses.

Every area has specific weed problems that are more serious than others. These are questions which dealers are being asked. How do you control quackgrass, Canada thistle, wild buckwheat, foxtail, etc.? When should it be sprayed? Are two applications necessary? How do you reduce corn brittleness? Dealers can be expected to respond favorably only if the educational program is geared to what they want and need.

Dealers have other problems, too, that are not directly related to weed control and crop production. These include better advertising, promotion techniques, credit control and other business practices. A panel discussion of dealers relating their successful experiences will generally bring out good ideas on this subject and encourage audience participation.

A dealer education program geared to what dealers themselves want and need cannot help but attract interest and stimulate action. What's more, an informed dealer can often do more to get his customers to follow recommended chemical weed control practices than any other member of the "educational team."

[1] The Dow Chemical Company.

THE ROLE OF EXTENSION SERVICE

Keith Wallace[1]

Importance of Working with Dealers

1. A dealer will be more apt to stock the right chemicals for the area he serves if he is properly informed at an early date. This would help him avoid having to dispose of merchandise not fitted to cope with a problem in the area.
2. Everyone who uses a herbicide must contact a dealer at one time or another. Many times the dealer contact is the only direct contact the user makes and in nearly every case the dealer is the last person to contact the user. Dealers also contact many people for reasons other than selling herbicides; therefore, he has opportunities to expand use of herbicides.
3. The dealer should be prepared to make the right recommendations to the customer as this may be the customer's only direct source of information. If so, he is relying on the dealer for information that will assure successful use of the product. Successful or unsuccessful use of the product can result in reactions that can affect both the dealer and the Extension program in one of two ways:
   a. Successful customer use means weeds killed as an immediate benefit. It also means there is possibility of a repeat performance by their customer as well as a demonstration to his neighbors who may also become customers and cooperators in any weed control program. This is important, as the neighborhood influence is one of the most powerful forces of public opinion.
   b. Unsuccessful customer use could result in a reaction opposite that described in (a) above, resulting in a loss of business for the dealer and a lack of effectiveness on the part of Extension Service.
4. Dealers sell many products. Therefore, they are not necessarily well-versed on all of their products. If he is well-versed on a particular product he will be more confident and more effective in selling the product. He will also be more apt to emphasize its importance to a prospective customer. In this way the product may get more attention from the dealer.
5. Close working relations with dealers can help the Extension Service become better acquainted with dealer and community problems, enabling them to do more effective work in the future.
6. Last but not least, working effectively with dealers can result in a better understanding of Extension Service and Experiment Stations by the dealer (with the possibility that it will reach many of his customers and associates). If this happens he may become more interested not only in the service rendered but in over-all operation and problems of the Agricultural College.

Methods That Can Be Used by Extension Service in Working with Dealers

1. Information meetings—This method has been used on both county and area basis. It is an effective way of bringing a number of dealers up to date at once. It can be most effective if done on a county basis or with a smaller group, and if followed up with methods listed below.
2. Furnish literature—Much of the information explained at the meeting may be forgotten. Printed information prepared in simple, precise form will serve as a reminder and a reference and will assure proper recommendations.
3. Personal contact—Although it is time-consuming, it is the most effective method of working with dealers. These contacts will be less time-consuming and more effective if used as a follow-up to numbers 1 and 2.
4. Work with dealers on demonstrations—A demonstration may be put out for several purposes. The dealer may learn more about his product by assisting in establishing the demonstration; he will also see how it works and how it compares to other products. At the same time the demonstration can be used to inform customers and prospective customers of the advantages of the particular product.
5. Tours—Taking dealers on timely, well-planned tours can show them the product of their sales effort.

Their observations can be valuable in the future of their business.

INFORMATION THAT SHOULD BE INCLUDED IN ONE OR MORE OF THE ABOVE METHODS

1. Food and Drug Administration regulations.
2. Importance of reading and properly understanding terms used on the label and how to use table information.
3. Local recommendations for use of herbicides.
4. Precautions for using chemicals.
5. Important specific chemicals to be used in a specific area.
6. New chemicals, their place and potential uses.
7. Special area problems and special area programs on weeds.

[1] Extension Weed Specialist, South Dakota State College.

REGULATORY WORKSHOP: WEED LAWS

Chairman, Howard T. Richards

PROVINCIAL WEED LAWS AND ENFORCEMENT IN ALBERTA

W. Lobay[1]

Legislation in the province of Alberta respecting weeds is enforced under The Noxious Weeds Act. This Act lists noxious weed and outlines the responsibilities and duties of persons owning, leasing, occupying or having an interest in land with respect to preventing noxious weed growth. Land is defined as "lands owned or occupied or controlled by a person and where (a) a road, road allowance, highway, street, lane or stream is contiguous to such land, the land up to the centre line or (b) a lake or body of water is contiguous to or included within such lands, the land up to the low water mark." "Person" includes a corporation, joint stock company and partnership. The Act outlines quite specifically the duties and powers of weed inspectors imposed upon them, how an inspector may enter land, destroy or direct the destruction of weeds or weed seeds found on land whether in a crop, building, machinery, etc.

The Noxious Weeds Act is administered on the local government or county level by officially appointed Weed Inspectors. This Act is administered on a provincial basis by the Minister of Agriculture through the Department of Agriculture—Field Crops Branch.

The Noxious Weeds Act is regulatory or enforcing legislation limiting it to a remedial measure rather than preventive. This method is sometimes not always the best method of coping with weed problems and problem farmers, although often necessary. Realizing this fact, the Agricultural Service Board Act was established in 1945 enabling local government or municipal (county) authorities to provide for the extension of agricultural service in conjunction with the provincial agriculture department. The Agricultural Service Board is made up of an equal number (usually 2) municipal council members and farmer members (also 2) along with the Department of Agriculture's local representative. A full-time field supervisor is employed by the municipality to carry out the programs of the Board. The duty of the Board is to act as an advisory body and to assist the municipal council and the Minister of Agriculture in matters of mutual concern. The Department of Agriculture may enter into agreement with the Council for assistance towards, among other things, control of noxious weeds.

The field supervisor is appointed, among other obligations which he must assume, a full-time weed inspector. He may have under his direction as many part-time weed inspectors as deemed necessary to carry out weed inspection during the weed season. However, the field supervisor in conjunction with the local Agricultural Representative or county agent approach the weed problem with the view to educating and encouraging the farming public to solve their own weed problem without the need of enforcement. At all times the field supervisor has full authority to use enforcement where action is not taken after suggestion and if he deems necessary.

An important feature of the Agricultural Service Board Act is the Board's power to supervise farming operations in connection with weed infestation or to take over the management and control of land for the purpose of reclaiming the land which has become impoverished through soil erosion, weed infestation or some other cause.

In almost all instances land which is placed under reclamation has previously been under weed destruction notices for some time and with no apparent success because the owner was either uncooperative or unable to cope with the weed situation on his farm.

In a municipal district or a county where an Agricultural Service Board has been organized, the weed inspector has a very significant advantage in administering the Weed Act, in that he does the work after discussing the situation with the five-member Board, who agree as to what action should be taken. The responsibility is divided among a number of persons instead of one. Furthermore, the extension officer is not directly connected with doing any actual enforcement work. All but 3 municipalities have Agricultural Service Boards organized.

[1] Supervisor, Soils and Weed Control, Alberta Department of Agriculture.

THE NOXIOUS WEEDS ACT FOR THE PROVINCE OF MANITOBA

J. O. Forbes

The Government of Manitoba realized long ago the economic importance of maintaining an aggressive weed control policy. The first Act was passed in 1894 and with numerous revisions, is still sound and operative today. During the early '20's a Weed Control Division was established in conjunction with the Publications Branch of the Department of Agriculture. This year Weed Control was transferred to the Soils and Crops Branch, assuming the title of Weed Control Section.

The Noxious Weeds Act defines responsibilities for weed control in Manitoba in three distinct classifications, namely: the land-owner or operator, the municipal council and the Department of Agriculture and Conservation.

The land-owner or operator is responsible for controlling weeds on: 1. His entire land holding; 2. Waterways passing through the property; and 3. One-half the road allowance of all roads and highways immediately adjoining the property. Farmers can be prosecuted for using seed grain containing weed seeds unknown in the district.

The Municipal Council is charged with: 1. Appointment of a "Municipal Noxious Weeds Inspector or Inspectors" to assume the council's responsibility in furthering weed control; 2. Destruction of noxious weeds on the one-half of any road allowance adjoining railway right-of-way, non-taxable land or unoccupied land within the municipality; 3. Levying taxes for weed control operations necessitated by a land-owner failing in his responsibility; 4. Taking over farms declared "weed infested" to implement an eradication program; and 5. Reporting weed infestations as well as preventing the spread of weed

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seeds generally. A Municipal Council may add any specific weed to those listed in the Act.

The Department of Agriculture and Conservation: 1. Appoints the Manitoba Weeds Commission to advise on all matters pertaining to weed control and weed administration within the Province; 2. Administers the Noxious Weeds Act through Department personnel who also extend information on weed control; 3. Ensures appointment of Municipal Weeds Inspectors; 4. Administers weed control in Municipalities which fail to comply with the act; and 5. Processes annual reports submitted by Weeds Inspectors dealing with the local situation and determines remedial action.

Major emphasis for weed control is on the municipal level with the land-owner primarily responsible for weed control on his property. Indifference of individuals and municipal authorities plus their lack of appreciation of the toll weeds take each year limits the effectiveness of the Manitoba Noxious Weeds Act. Greater awareness of the importance of the weed problem should help to correct the present situation.

THE SASKATCHEWAN NOXIOUS WEEDS ACT

T. V. Beck[1]

In Saskatchewan there are two laws which cover the spread of weeds: The Canada Seeds Act, and the Noxious Weeds Act. The Canada Seeds Act covers the sale of material for seed purposes only, is administered by the Canada Department of Agriculture, and is Canada-wide. The Noxious Weeds Act is a provincial act and is the one with which we will deal here. Briefly, the Noxious Weeds Act lists the weeds to which the Act applies and outlines the duties and responsibilities of various agencies with regard to weed control. In addition it outlines the procedures to be followed in administering the Act and lists the offences under the Act and the penalties for which one is liable on conviction.

Duties of agencies are outlined briefly as follows:

(a) It is the duty of the owner or occupant to destroy weeds and prevent their spread. For the purposes of the Act, all public roads, including highways, are the property of the municipality. This differs from the Act in adjoining provinces, where the farmer is responsible for roadsides adjacent to his property.

(b) It is the duty of the Department of Agriculture to:

1. Declare weeds noxious where it is deemed necessary. The Act contains a list of about 35 weeds which have been declared noxious throughout the years. A weed may be declared noxious by a Minister's Order published in the Saskatchewan Gazette. The main advantage of this simple procedure is that a newly-introduced weed can be declared noxious as soon as discovered and before too much spread has taken place. However, it has the disadvantage of building up a long list of noxious weeds, many of which may have appeared serious at first, but have eventually proved to be of little consequence. The Act does not list different categories of weeds, but all are listed merely as noxious. There is, however, some distinction made between different weeds in the main body of the Act. For example, land can be taken from the farmer temporarily for the control of only leafy spurge, hoary cress, Russian knapweed and toadflax.

2. Provide up-to-date information on weed control. This information is provided mainly through leaflets and bulletins. In addition a four-day weed inspectors course is held yearly. This course is designed to provide weed inspectors with up-to-date information on weed control and utilizes the assistance of personnel from research, university and extension agencies throughout the province.

3. Conduct investigations necessary and assist in the proper administration of the Act.

(c) It is the duty of the municipality to administer the Act through its local weed inspector. To facilitate weed control it may:

1. Make agreements for weed control with owners.

2. Temporarily take control of, and farm, infested lands.

3. Form joint weed control committees with other municipalities.

4. Charge costs of weed control against the land in the same manner as taxes.

5. Pass certain bylaws with regard to the spread of weeds.

The Act also outlines the powers and duties of the appointed weed inspector. His powers are based on the theory that education is preferable to force as is indicated by the procedure for serving an order. He must first visit the farmer and try to make a satisfactory agreement with him for control. Only if he is unable to make such an agreement may he issue an order for destruction. However, the weed inspector has sufficient authority to enforce weed control if necessary by: preventing the seeding of a crop, having the crop destroyed, outlining methods which must be carried out and by the use of chemicals. He may also prevent the movement of infested materials and screenings.

Unfortunately our Act states only that a municipality may appoint a weed inspector, rather than must appoint a weed inspector. Even where weed inspectors are appointed they are often inspectors in name only. In order to encourage better weed control programs in the province, the Department has, since 1952, assisted in hiring district weed supervisors. Under this scheme, six or more municipalities may join together to hire a weed supervisor on a district basis. Half the cost of the wages and travelling expenses of the supervisor, to a maximum of $150 per municipality is paid by the Department. The supervisor is appointed as weed inspector in each of the municipalities taking part, but his activities are directed by a central weed committee made up of municipal representatives. Where this scheme is in operation the municipalities may appoint local weed inspectors in addition to the district supervisor. This works well, because it makes a local contact for the supervisor and leaves someone to continue the work while the supervisor is absent.

Where supervisors are hired, much of the emphasis is placed on extension rather than regulatory work. We feel that the Noxious Weeds Act provides muncipalities with sufficient authority to enforce good weed control, but without the majority of the farmers co-operating this is almost impossible. It is first necessary to educate the majority and then punish the remaining few. Municipalities are generally satisfied with the program. The program, with supervision to provide more publicity, education, and enforcement, should be continued.

In view of this survey the program has been continued with only minor changes. More stress has been placed on supervision, education and farmer participation. Units operated by municipalities have taken much of the responsibility from the farmer and often he has ceased to take a sufficiently active part in the control program. Now, with granular chemicals requiring little or no equipment for application, and with added supervision and education, we hope that farmer participation can once again be obtained. Only with the active participation of every farmer can we expect to obtain satisfactory weed control.

[1] Saskatchewan Department of Agriculture

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THE KANSAS NOXIOUS WEED LAW

Warren C. Teel[1]

Weeds declared noxious in Kansas are field bindweed, hoary cress, Russian knapweed and Johnsongrass, the last of which is by county commissioner resolution. The law states that persons, state agencies, railroads, cities, school boards, township boards, etc. shall control the spread of and eradicate all weeds declared noxious and use methods approved by the State Board of Agriculture. The law provides for cooperation in actual treatment of other weeds.

The Weed Divsion of the State Board of Agriculture employs a director and five assistant directors as provided by the act. Assistants are assigned a weed control district to consult, advise and render assistance and direction to county and city weed supervisors. The director enforces rules and regulations of the board and the law. The county extension agent is assigned the educational phase of weed control.

Boards of county commissioners employ a county weed supervisor and incorporated cities may employ a supervisor. Their duties include consulting and cooperating with the Noxious Weeds Division of the State Board of Agriculture, location of infestations, making surveys, compiling data on areas eradicated and under treatment, submitting required reports to commissioners and the State Board of Agriculture, consulting and advising on methods of control and eradication, investigating or aid in investigation and prosecution of any violation, and report same to the county attorney. An annual progress report is filed bv January 15 each year with the State Board of Agriculture.

The county assessor is assigned the duty of surveying infestations and transmitting such data to proper authorities. On the basis of this report, local tax units shall make a levy for the purpose of paying their part of the cost of weed control. Such funds are set apart as a noxious weed eradication fund.

Cost of control and eradication of noxious weeds on publicly owned lands is paid out of funds available for that purpose. On other lands, the owner pays the cost, provided that chemical materials for use on privately owned lands may be purchased from the county commissioners at one-half cost.

Commissioners shall purchase or provide the necessary equipment, labor and chemical material for the control and eradication of noxious weeds. Chemicals are sold to the landowner at one-half cost and he pays the actual cost of operation charges for equipment and labor, provided official methods of control are followed. The landowner may furnish his own equipment and labor.

If anv political subdivision owning or supervising lands, infested with noxious weeds, within their jurisdiction, has failed to endeavor to control such noxious weeds, after a fifteen day notice directing the body to do so, the county commissioners shall proceed to have proper control methods used upon such land and notify the body with demand for payment. When any persons or corporation, owning or supervising land infested, fails to comply with the act, the commisioners, city officials, or county supervisor shall give written notice to the owner or agent.

Anv person, corporation, county, city, or other official, who violates or fails to comply with the act, shall be guilty of a misdemeanor and shall be punished upon conviction bv a fine of not less than fifty dollars nor more than five hundred dollars for each count.

It is unlawful for persons to sell, offer for sale, give away, or otherwise dispose of screenings or offal material containing noxious weed seed, unless first processed to destroy viability of weed seeds or sold to commercial provessor. It is also unlawful to dispose of nursery stock, plant packing material, animal fertilizer, soil or sod that contains or is infested with noxious weed plant material or seeds. Livestock feed material cannot be sold or given away, if infested, except if such feeds are consumed on the same farm where grown, or sold to commercial processor or feed mixer. Livestock feed which is infested, must be fed on the premises where grown unless it is processed.

It is unlawful for any person or company to bring harvesting equipment or any other farm machinery or vehicles into the state, or to move them from an infested field or farm to another, without first cleaning them free from all weed seed and litter. Each such machine doing custom work shall carry a label containing this section of the law.

County commissioners, township boards, city officials, and state, county and city weed supervisors, shall have at all times, free access to enter upon premises to inspect property in connection with the administration of the state weed law.

Note: In Kansas, the weed law and seed law are separate and administered by the Weed and Control Divisions respectively. Under the seed law, it is unlawful to sell agricultural seed containing field bindweed, hoary cress, Russian knapweed, leafy spurge, or perennial sorghums, such as, but not limited to, Johnsongrass, sorghum almum, and perennial sweet sorgrass. Fourteen other weeds are listed and must appear on the label, indicating the number per pound of agricultural seed.

[1] Director, Noxious Weeds Division, Kansas State Board of Agriculture.

THE MINNESOTA WEED LAW

Sig. Bjerken[1]

Under the Minnesota Weed Law any annual, biennial or perennial plant that is injurious to public health, public roads, livestock and other property and so deemed by the Commissioner is considered a noxious weed and may be destroyed at such time and in such manner as is determined by the commissioner or local weed inspector having jurisdiction. Seventy-one weeds are on the noxious weed list at the present time. The main reason for this is that there are different weed problems in different sections of the state. Then, too, as new weeds have threatened our state they have been placed on the list so that when they do appear we are in a position to deal with them before they get out of hand. This is an important feature of our law, as we do not need new legislation in order to eradicate weeds as they appear.

The State of Minnesota is divided into 1831 townships, of which the three town board members are weed inspectors by law, and 831 villages and cities, of which the mayor is the weed inspector by law. In addition, the law provides that they may appoint assistants in carrying out their duties, and some 300 township and village inspectors are appointed annually, making a total of approximately 6624 weed inspectors whose services are paid for by the local governments. Ninety-three county-wide meetings are held annually as training courses for these inspectors.

The law provides that they shall check every tract of land under their jurisdiction and cause to be destroyed noxious weeds which exist thereon. The law also provides that the county boards, upon request of the Commissioner of Agriculture, shall appoint a county weed supervisor to supervise the program in the county. All of the 87 county boards of the state complied with this provision and at the present time some 70% are rendering 12 months service. These county inspectors are paid by their respective counties out of county funds. A 4-day Short Course is held annually as a training course for the county inspectors as well as the district and state staff in order that they may give the best

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seeds generally. A Municipal Council may add any specific weed to those listed in the Act.

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Warren C. Teel[1]

Weeds declared noxious in Kansas are field bindweed, hoary cress, Russian knapweed and Johnsongrass, the last of which is by county commissioner resolution. The law states that persons, state agencies, railroads, cities, school boards, township boards, etc. shall control the spread of and eradicate all weeds declared noxious and use methods approved by the State Board of Agriculture. The law provides for cooperation in actual treatment of other weeds.

The Weed Divsion of the State Board of Agriculture employs a director and five assistant directors as provided by the act. Assistants are assigned a weed control district to consult, advise and render assistance and direction to county and city weed supervisors. The director enforces rules and regulations of the board and the law. The county extension agent is assigned the educational phase of weed control.

Boards of county commissioners employ a county weed supervisor and incorporated cities may employ a supervisor. Their duties include consulting and cooperating with the Noxious Weeds Division of the State Board of Agriculture, location of infestations, making surveys, compiling data on areas eradicated and under treatment, submitting required reports to commissioners and the State Board of Agriculture, consulting and advising on methods of control and eradication, investigating or aid in investigation and prosecution of any violation, and report same to the county attorney. An annual progress report is filed by January 15 each year with the State Board of Agriculture.

The county assessor is assigned the duty of surveying infestations and transmitting such data to proper authorities. On the basis of this report, local tax units shall make a levy for the purpose of paying their part of the cost of weed control. Such funds are set apart as a noxious weed eradication fund.

Cost of control and eradication of noxious weeds on publicly owned lands is paid out of funds available for that purpose. On other lands, the owner pays the cost, provided that chemical materials for use on privately owned lands may be purchased from the county commissioners at one-half cost.

Commissioners shall purchase or provide the necessary equipment, labor and chemical material for the control and eradication of noxious weeds. Chemicals are sold to the landowner at one-half cost and he pays the actual cost of operation charges for equipment and labor, provided official methods of control are followed. The landowner may furnish his own equipment and labor.

If any political subdivision owning or supervising lands, infested with noxious weeds, within their jurisdiction, has failed to endeavor to control such noxious weeds, after a fifteen day notice directing the body to do so, the county commissioners shall proceed to have proper control methods used upon such land and notify the body with demand for payment. When any persons or corporation, owning or supervising land infested, fails to comply with the act, the commisioners, city officials, or county supervisor shall give written notice to the owner or agent.

Any person, corporation, county, city, or other official, who violates or fails to comply with the act, shall be guilty of a misdemeanor and shall be punished upon conviction by a fine of not less than fifty dollars nor more than five hundred dollars for each count.

It is unlawful for persons to sell, offer for sale, give away, or otherwise dispose of screenings or offal material containing noxious weed seed, unless first processed to destroy viability of weed seeds or sold to commercial provessor. It is also unlawful to dispose of nursery stock, plant packing material, animal fertilizer, soil or sod that contains or is infested with noxious weed plant material or seeds. Livestock feed material cannot be sold or given away, if infested, except if such feeds are consumed on the same farm where grown, or sold to commercial processor or feed mixer. Livestock feed which is infested, must be fed on the premises where grown unless it is processed.

It is unlawful for any person or company to bring harvesting equipment or any other farm machinery or vehicles into the state, or to move them from an infested field or farm to another, without first cleaning them free from all weed seed and litter. Each such machine doing custom work shall carry a label containing this section of the law.

County commissioners, township boards, city officials, and state, county and city weed supervisors, shall have at all times, free access to enter upon premises to inspect property in connection with the administration of the state weed law.

Note: In Kansas, the weed law and seed law are separate and administered by the Weed and Control Divisions respectively. Under the seed law, it is unlawful to sell agricultural seed containing field bindweed, hoary cress, Russian knapweed, leafy spurge, or perennial sorghums, such as, but not limited to, Johnsongrass, sorghum almum, and perennial sweet sorgrass. Fourteen other weeds are listed and must appear on the label, indicating the number per pound of agricultural seed.

[1] Director, Noxious Weeds Division, Kansas State Board of Agriculture.

THE MINNESOTA WEED LAW

Sig. Bjerken[1]

Under the Minnesota Weed Law any annual, biennial or perennial plant that is injurious to public health, public roads, livestock and other property and so deemed by the Commissioner is considered a noxious weed and may be destroyed at such time and in such manner as is determined by the commissioner or local weed inspector having jurisdiction. Seventy-one weeds are on the noxious weed list at the present time. The main reason for this is that there are different weed problems in different sections of the state. Then, too, as new weeds have threatened our state they have been placed on the list so that when they do appear we are in a position to deal with them before they get out of hand. This is an important feature of our law, as we do not need new legislation in order to eradicate weeds as they appear.

The State of Minnesota is divided into 1831 townships, of which the three town board members are weed inspectors by law, and 831 villages and cities, of which the mayor is the weed inspector by law. In addition, the law provides that they may appoint assistants in carrying out their duties, and some 300 township and village inspectors are appointed annually, making a total of approximately 6624 weed inspectors whose services are paid for by the local governments. Ninety-three county-wide meetings are held annually as training courses for these inspectors.

The law provides that they shall check every tract of land under their jurisdiction and cause to be destroyed noxious weeds which exist thereon. The law also provides that the county boards, upon request of the Commissioner of Agriculture, shall appoint a county weed supervisor to supervise the program in the county. All of the 87 county boards of the state complied with this provision and at the present time some 70% are rendering 12 months service. These county inspectors are paid by their respective counties out of county funds. A 4-day Short Course is held annually as a training course for the county inspectors as well as the district and state staff in order that they may give the best

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possible service and the latest information to the people in their respective districts and counties.

The law is administered by the Commissioner of Agriculture through the Director of the Division of Plant Industry and under the supervision of the Section of Weed Control, aided by an agronomist and 11 district weed and seed inspectors, each having a district. These district inspectors not only supervise the weed program in their districts but also are the seed, feed and fertilizer inspectors in the state. The services of these district inspectors are paid for out of state funds.

The law requires a legal weed notice shall be published annually before June 15 by each township and village, directed to the people of the respective municipalities and townships to the effect that weeds shall be destroyed by June 15 and as often as necessary thereafter to prevent them from going to seed.

Minnesota includes approximately 51 million acres of land, of which 30% is tax-exempt land. Under the Minnesota Law we may enter upon such land to destroy weeds if those in charge fail to do so, and all costs incurred can be paid for out of funds provided by the legislature of our state. In order to carry out an effective program in the state it is essential that the law cover all lands as weeds are a menace to adjacent lands wherever they exist.

On lands on which owners are financially unable to pay the cost of weed eradication the law provides that the commissioner may quarantine such tracts and the costs incurred for weed eradication on such land is paid on the basis of 10% by the township, 20% by the county and 70% by the state when the quarantine is located in a township. When the quarantine is located in a village the cost is paid 50% by the village and 50% by the state. Many infestations in our state would have gotten out of hand had it not been for this provision in the law.

Weeds on property owned by railroads, public utilities, etc. and on state, county and township road, cemeteries, etc. are destroyed at the expense of the property benefitted. Weeds in abandoned cemeteries are paid for at the expense of the county.

Failure of an owner to comply with the notice in the control of his weeds within the time given him by the local weed inspector gives the inspector the right to carry out the provisions of the notice, and when the work has been completed all costs incurred are filed with the county and a warrant is issued immediately. In other words, the weeds were destroyed, the man who performed the work was paid for the labor and the auditor places it on the books as a lien against the property and adds it to the real estate taxes. This provision is most important in that people generally know that if they do not destroy their weeds someone will do it for them. However, every person is given the opportunity to destroy their own weeds. No arrests are necessary in our state in order to deal with the non-cooperator under this provision of the law.

Weed in crops may be destroyed by following the provisions of the law and no damages need be paid for any losses that may occur.

The law provides that it shall be the duty of every person owning or operating equipment used in the harvesting of crops immediately after completion at each point of harvest, or in transit, to cause the machine to be cleaned, together with grain hauling equipment. Seed, screenings, forage, straw, soil, gravel, sand, etc. containing seed or propagating parts of leafy spurge, horse nettle, Austrian field cress, field bindweed, perennial peppergrass, wild radish, sowthistle, Canada thistle, and hoary alyssum, can be transported only on certain conditions set up by the local weed inspector.

The Town Boards at their annual town meeting may submit to a vote by ballot whether persons owning or occupying real estate adjoining town roads shall be required to cut, destroy or remove all weeds and grass growing upon the town road adjacent to their lands. If it carries it becomes effective and will remain in effect until such time as it is repealed. Weeds on forfeited lands—10% of the revenue derived from the sale of such lands or crop can be used for weed control. In closing, may I say, the Minnesota Weed Law is fair since it gives the individual the first opportunity to take care of his own weeds.

[1] Minnesota Dept. of Agriculture, Division of Plant Industry, St. Paul.

THE NEBRASKA WEED CONTROL PROGRAM

Leon W. Kreiner[1]

The weed control program in Nebraska was initiated in 1937 with the enactment of the noxious weed law. This law provided for the establishment of weed districts for the control and eradication of noxious weeds in the state of Nebraska.

Local districts are administered by supervisors that are elected by the landowners at the organization meeting and at succeeding annual meetings held during the first quarter of each year. Each district has from 3 to 5 supervisors. These supervisors meet upon the call of the chairman to discuss and promote weed control in their assigned area. Most districts meet regularly once a month. The supervisors receive their necessary traveling expenses and are reimbursed for the time actually spent in the performance of their duties.

The supervisors have the power to employ field supervisors, purchase equipment and lease or purchase land and buildings. The districts operate sprayers and seed cleaners and sell herbicide material to landowners at cost. They have the power to treat noxious weed infested lands within their boundaries and charge the actual cost of such operation to the landowners. The districts are allowed to do a limited amount of pest control work. At the present time, we have a number of counties in Western Nebraska controlling prairie dogs. Rural districts are financed through assessment of all tangible rural property within the district boundaries. Towns and cities may levy a tax for weed control within their corporate limits. The State of Nebraska, governmental subdivisions, public corporation, and railroads are required by law to put in effect a plan for the control and eradication of noxious weeds infesting their property when such property is within or adjacent to any district. Any person, firm or corporation that has not put into effect such plans by May 1 of each year may be punished as provided by law.

The noxious weed law provides for the cleaning of combines and seed cleaning machines when moved from a farm that is infested with noxious weeds or before entering the boundaries of the State of Nebraska. During the wheat harvest season, inspection points are set up at Ports of Entry in our major wheat growing areas. Combines, trucks, and trailers that enter the state are inspected and tagged if clean. Operators of uncleaned equipment are required to clean such equipment and where a direct violation of the law is observed, the operator is prosecuted. This past season 5,878 combines were inspected by personnel employed by the Weed and Seed Division.

The law also states that: (1) No seed, feed, grain or other material containing noxious weed seed shall be sold within the state unless processed or sold for the purpose of such processing as will remove or destroy the viability of the noxious weed seed. (2) Any material such as soil or sod that may be impregnated with noxious weed seed or parts of a plant that could cause new growth may not be moved from the premises on which it is located. These provisions of the law are enforced by 5 members of the staff of the Weed and Seed Division and 50 county inspectors who are trained by the Weed and Seed Division and administered by the Weed districts.

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Violators of the noxious weed law may be fined any sum not less than $10.00 nor more than $500.00.

At the present time there are 9 designated noxious weeds in the state of Nebraska. They are: bindweed, Canada thistle, hoary cress, leafy spurge, Russian knapweed, puncture vine and bur ragweed. Johnsongrass and musk thistle were added to the list by the Nebraska Legislature this year. The Director of Agriculture may, after public hearing, designate weeds of a similar character as noxious weeds.

The Director of Agriculture through the personnel in the Weed and Seed Division supervises weed districts and is charged generally with the enforcement of all provisions of noxious weed law. He may also call to his assistance members of the faculty and employees of the College of Agriculture of the University of Nebraska and the Agricultural Extension Service of the University of Nebraska as may be necessary to assist districts in the control and eradication of noxious weeds.

The noxious weed law also provides for a state weed advisory committee. The duties of this committee are to maintain at all times the closest cooperation between the Department of Agriculture and Inspection and the College of Agriculture in carrving out purposes of the law and to formulate general plans and specifications for the control and eradication of noxious weeds. The committee shall also assist and advise in educational work relative to weed identification and eradication and assist in the promotion and organization of weed control activities. The chairman of this committee is the Director of Agricultural Extension and the members are the Chairman of the Department of Agronomy, the President of Nebraska Crop Improvement Association, and the President of the State Horticultural Society.

Nebraska Weed and Seed Division activities include a state weed conference and equipment show which is held annually for the dissemination of information to weed control personnel, county agricultural agents, and others interested and concerned with weed control.

Funds are acquired by providing exhibit space to chemical and equipment companies at this conference. These funds are utilized in promoting better conferences in future years and financing educational weed programs.

One phase of the educational program is the preparation of noxious weed seed identification mounts. These mounts are used by weed control workers and agricultural educators in their respective weed education programs.

Numerous publications are published by the Weed and Seed Division to aid the districts in the administration of operation of their programs. Plans are underway to publish a bulletin containing control measures and colored illustrations of Nebraska's noxious weeds.

[1] Chief, Weed & Seed Div., Nebraska Department of Agriculture.

NOXIOUS WEED LAW ENFORCEMENT IN WISCONSIN

Howard T. Richards[1]

Local systems of government vary between the states. In certain states represented here to-day, the county government is the local government and the governing body consists of a small board of county commissioners. However, in Wisconsin, each town, village and city is a unit of government with its own governing board or council. In each county there is a county government also. Its governing board consists of one or more representatives from each town, village and city within the boundaries of the county.

Most people are familiar with the terms village and city. However, everyone present may not know what I mean by a town. A town is a unit of government representing a geographical area usually known as a township.

Each local government is responsible for law enforcement within its boundaries. This situation applies to some state laws as well as local ordinances. An example is the state noxious weed law. Wisconsin Statutes place the primary responsibility for the enforcement of this law with the 1,830 local units of government within the state. The law provides that county boards may adopt county noxious weed control programs but to date only three counties have done so.

A law enforcement system of this type is complex, yet it has advantages. It is democratic because it permits governments at the local level to solve their own problems. One person, the highest elected official, is in charge. He is authorized to post and publish the annual noxious weed notices, appoint the local weed commissioner and supervise his work. The local board may add to the state list of three noxious weeds, determine the compensation of the local weed commissioner and provide equipment for him to work with.

Through its weed commissioner, the local government may investigate for noxious weeds, serve notices requiring noxious weeds to be destroyed and enter property to destroy noxious weeds when the owner or occupant fails to do so after being properly notified. The cost of destroying noxious weeds may be charged to the landowner through the local tax rolls. Also, a penalty is provided which may be applied to both land-owners and/or occupants who refuse to cooperate or who interfere with the duties of the weed commissioner.

This system of noxious weed law enforcement appears to be sound and practical. An adequate law is provided by the state. Authority to enforce it is delegated to the local units of government which are close to the people. In actual practice, however, is this system of local enforcement of a state law effective? The answer is "Yes" if there is sufficient interest in noxious weed control in any given municipality. If interest is lacking, then enforcement is too.

There are reasons why this irregular pattern of noxious weed law enforcement exists. Down through the years, weed control has been difficult. In fact, until the last decade there have not been easy, effective and economical weed control methods. Consequently, weed law enforcement has not been popular. As previously pointed out, the authority has been decentralized. If a local government preferred not to enforce the law, there has not been a central authority to step in. Because noxious weed law enforcement has been unpopular, too few responsible citizens have been willing to accept the position of weed commissioner. Their reasoning has been that they would rather live with the weeds than fight with their neighbors. Some local officials have expressed essentially the same reasoning.

The authority of the state in the enforcement of the noxious weed law is limited to duties delegated to the State Department of Agriculture. The department may call meetings of the weed commissioners in any county for inspection and discussion of means and methods necessary for the proper performance of their duties; prescribe the forms, blanks, and instructions to be used in the execution of said work; and to inspect the work of the weed commissioner.

Each year the Seed and Weed Section of the department does arrange and conduct a series of county meetings to which are invited weed commissioners, local officials and other people who have an interest in and a responsibility for noxious weed control and noxious weed law enforcement. Recommended forms and instructions are supplied to the weed commissioners and local officials as necessary. Through its authority to inspect the work of the weed commissioners, the department enters into such enforcement problems as noxious weed complaints when they cannot be settled locally. The department, in these situations, acts as an arbitrator rather than an enforcement agency. Service work pro-

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vided by the department includes weed identification, contacting officials of other state departments and public agencies when noxious weed problems arise on lands owned or controlled by such agencies. The department also assists county committees when they are interested in planning and establishing a county weed control program and assists the county weed commissioner to get started in his work.

At its best, the system of weed law enforcement in Wisconsin lacks uniformity. Changes in the law and other types of programs have been suggested. It is unlikely that legislation alone will be the answer. The problem to be solved is that of creating enthusiasm for weed control. What is needed is an expanded and integrated educational program in which the regulatory, extension and research phases each share their rightful place.

[1] Wisconsin State Department of Agriculture.

CHEMICAL CONTROL OF COUCH GRASS

Corns, Wm. G.[1]

During each of the past three years, amitrol, dalapon, and TCA were compared as foliage and as soil treatments for couchgrass, in combination with roto-tillage preceding and/or following the application of the chemicals. Amitrol at 15, 30, and 60 lb/A; dalapon at 30 and 50 lb/A; and TCA at 60 and 100 lb/A were applied in 100 gal/A water, on duplicate 100 sq ft plots for each treatment, in a field having dense grass sod in black loam soil at Edmonton. Respective areas were tilled either immediately before the chemical treatments of bare soil in early July, or two weeks after the foliage sprays when the leaves had become discolored. Subsequent tillage was repeated, where regrowth warranted it, during the remainder of the season. In one of the experiments parts of the areas were seeded with creeping red fescue and other parts were seeded after another cultivation the following spring. Periodic records of numbers of shoots of couchgrass per unit area were kept for all plots and representative photographs were taken to illustrate results by late summer of 1959. During June of this year, comparisons of TCA at 50 and 100 lb/A; Fenac (sodium salt of 2,3,6-trichlorophenylacetic acid), and cacodylic acid at 5, 15, and 30 lb/A were commenced in a similar experiment, in addition to preliminary trials to test for selectivity of Fenac sprayed on couchgrass, creeping red fescue and Kentucky bluegrass (Research Report).

General conclusions were that:

1. Amitrol was almost completely ineffective for killing rhizomes. Four cultivations, after application of 30 lb/A amitrol, were inadequate to prevent regrowth of couchgrass. A higher rate, 60 lb/A (approx. $4/lb), was not appreciably better.

2. Dalapon was somewhat more effective than amitrol but much less satisfactory than TCA in comparisons involving foliage spray followed by an essential post-treatment cultivation within two weeks after chemical treatment. Dalapon caused impressive top-killing but regrowth was extensive. Regrowth by 1959 on plots treated in 1957 with 50 lb dalapon/A, costing more than $50/A was more than 90% of controls as compared with less than 5% after use of 60 lb TCA/A, costing less than $30/A, when the chemical treatments were followed by the single cultivation in the summer and a pre-seeding cultivation the next spring.

3. Foliage applications of TCA followed by one cultivation two weeks later were as effective as TCA applied to the soil after cultivation.

4. There was temporary inhibition of lawn grass and thinning of the stand in some of the plots seeded within 6 weeks after application of TCA and dalapon but there was no evidence of residual toxicity affecting grass seeded in the spring following the year of the treatments.

5. In the tests begun in 1959 the preliminary results from TCA followed by a tillage were consistent with those of earlier experiments. Couchgrass in untilled areas, however, was suppressed only temporarily by foliage sprays of any of the chemicals. There was extensive regrowth on all plots treated with cacodylic acid, even when tilled afterwards. Fenac at 15 and 30 lb/A prevented growth of annual weeds as well as virtually all regrowth of couchgrass on areas tilled once, about 1 month after chemical treatment. Accordingly this chemical, though expensive at present (approx. $5/lb), appears worthy of attention in continued similar studies with couchgrass. In the different approach, in 1959, involving Fenac sprayed on couchgrass, creeping red fescue and Kentucky bluegrass (Research Reports) the results did not appear to show promise of sufficient selectivity.

[1] Division of Crop Ecology, Dept. of Plant Science, University of Alberta.

CHEMICAL AND CULTURAL CONTROL OF ABSINTH

G. W. Selleck[1]

Absinth is a perennial forb which was apparently introduced to Saskatchewan from Europe during the 1930's. Serious infestations have been found in the Luseland-Denzil, Cypress Hills, and Penzance-Dilke districts and small infestations have been found in numerous other places in Saskatchewan. The weed is present in Manitoba, along roadsides, in farm yards and pastures and has been noted in Alberta and South Dakota. The plant is particularly troublesome in pastures since it causes an unsavory flavor in dairy products when eaten by milchcows. The weed invades rapidly in over-grazed pastures resulting in a severe deterioration of the pasture. Once established in grain fields, the plant is difficult to eradicate. Again because of its strong aromatic odour, its presence in harvested grains causes them to grade "rejected" even when present in small amounts.

Good cultural practices will prevent the establishment of absinth in cultivated fields. This may be attested to by the presence of the weed along roadsides continuously for 65 miles in Saskatchewan and Manitoba with only slight to moderate invasion into cropland. A routine black summerfallow and fall tillage are effective in preventing the invasion of the weed, since germination of the seed occurs from mid-summer to fall. At this stage, a single tillage operation is sufficient to eradicate the seedlings. Spring tillage is somewhat less effective since the species by this time has become sufficiently hardy to tolerate more than one tillage operation. Established stands of absinth in a cultivated field may be eradicated with difficulty by an intensive summerfallow. The roots of the tall, coarse plants are difficult to sever by tillage implements. Occasionally a root may reach 2.5 inches in diameter. However, repeated tillage operations which destroy all top growth will result in complete eradication of the weed in one year.

Extremely dense infestations may occur in pastures, yards or roadsides particularly where there is disturbance. In areas such as these, the weed may be controlled by either breaking up the area and summerfallowing it, or attacking the infestation with herbicides. Since 1957, 12 12x20 ft plots and 38 15x100 ft plots were established in stands of absinth at two locations in abandoned land and pasture with the following herbicides: Mixed iso-octyl esters of 2,4,5-T, mixed iso-octyl esters of 2,4-D+ 2,4,5-T, 2,3,6-TBA, amitrol, dalapon, mixed amines of 2,4-D, mixed butyl esters of 2,4-D, mixed butyl esters of MCPA, a mixture of chlorinated benzoic and cresoxy-acetic acids (CP 1815), erbon, a BDM, and borax. Appli-

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cations were initiated at various times throughout the season and retreated until eradication was obtained. 2,3,6-TBA, amitrol and mixed esters of 2,4-D provided 100% control with one application at 14 lb/A or 2 applications during the same season at a rate of 4 lb/A. Borax at 1000 lb/A maintained 100% control of absinth while the 500 lb/A rates of borax and a BDM maintained 90 to 95 per cent control. Rates (lb/A) required for various percentages of control by systemic herbicides are presented in Table 1.

Table 1. Applications and amounts (lb/A) of herbicides required for absinth control.

Herbicide	Initial date of spraying	Amounts (lb/A) required to give the indicated percentages of absinth control: Two app. 1957, One app. 1958 — 100	75	One app. 1957, One app. 1958 — 100	75
2,4-D mixed esters		1.1	—	1.5	0.9
2,4-D mixed amines		2.4	2.1	2.4	0.9
MCPA butyl ester		1.1	—	2.1	0.9
2,4,5-T ester		2.4	—	2.1	0.9
2,4-D + 2,4,5-T esters		0.9	—	0.5	—
		Two app. 1958, One app. 1959 — 100	75	One app. 1958, One app. 1959 — 100	75
2,4-D,-2,4,5-T ester	May 23	1.5	0.5	1.5	0.2
2,4,5-T ester	May 23	2.8	1.2	1.6	0.4
Erbon	May 23	4.0	2.0	8.0	2.9
CP 1815	May 23	0.8	0.1	1.4	0.5
2-4-D butoxy-ethanol ester	May 23	0.7	0.2	1.0	0.2
2,4-D mixed esters	May 23	1.0	0.6	1.5	0.2
2,4-D mixed esters	June 24	0.7	0.2	1.5	0.4
2,4-D mixed esters	July 15	—	—	1.5	0.2
2,4-D mixed esters	Aug. 20	—	—	1.0	0.2

It is to be noted that one application of 2,4-D ester at a rate of 1.5 lb/A in each of two consecutive years provided complete control of the weed. In addition, two applications in one year followed by a third application the second is very little more effective than one application in each of two years. Heavier applications of herbicides are necessary where there is no competition from grasses. Erbon appears to be less effective than some of the other herbicides, while CP 1815 shows promise and should be tested further. The time of the initial application with 2,4-D did not significantly affect the over-all control, provided treatments were followed by a second spring application to regrowth the following year. There is an indication, however, that best results are obtained with the initial spraying applied in fall. In these tests, the low volatile butoxyethanol ester of 2,4-D was somewhat more effective than the standard mixed esters.

[1] Dept. of Plant Ecology, University of Saskatchewan, Saskatoon, Sask.

PROGRESS REPORT BENZOIC ACID WEED KILLERS

Arden M. Aanestad[1]

Two herbicides based on chlorobenzoic acids became available commercially in 1958: the dimethylamine salt of trichlorobenzoic acid, and the dimethylamine salts of mixed polychlorobenzoic acids. Use-cost of the two products is about the same.

Trichlorobenzoic acid has been widely used at rates of 10 to 20 pounds acid per acre (or polychlorobenzoic acid at 20 to 40 pounds acid per acre) as a spot treatment on bindweed. Control has been uniformly good with many instances of complete eradication. Best results are obtained when the spray is applied to actively growing foliage. Root absorption plays a very important part in the kill of bindweed, and moisture is required to carry some of the material into the ground. Applications made in the fall in western plains states, with 10 to 20 inches of winter and spring rainfall following treatment, appear to have given near optimum control.

In addition to control of bindweed, these products have been recommended for control of some other important noxious weeds, including Russian knapweed, leafy spurge, bur ragweed, and Canada thistle.

Trials in croplands by some state and federal research workers, such as in South Dakota and Montana, indicate that much lower rates of trichlorobenzoic acid, two to six pounds per acre, followed by cultivation or summer fallow, may give good control of noxious weeds, with the possibility of following the treatment with grain or other crops which are partly tolerant to the chemical. So far, however, this work is strictly in the research phase and no commercial use may be made of such treatments.

Field tests during the past two years have shown the chlorobenzoic acid compounds to be promising for control of a number of weed species for which the products are not presently recommended. These include wild garlic, blueweed, bouncingbet, phragmites, silver nightshade, yellow starthistle, and Russian thistle. Many of the annual species have been well controlled through the germinating season by early spring applications of two to five pounds trichlorobenzoic acid per acre.

In the field of brush control, these products appear to fit the role of a specialist in that they are particularly effective on certain species such as trumpet vine, honeysuckle, smilax, wild roses, sumac, persimmon, sassafras, and conifers, including spruce, balsam fir, cedar, pine, and juniper. Trials in 1958 and 1959 show that combinations of trichlorobenzoic acid with ammonium sulfamate or amitrol give superior brush control.

Another possible use for these products may be for chemical summer fallow. One to two pounds of trichlorobenzoic acid per acre applied in May following one thorough cultivation has shown promise on annual broadleaved weeds and some grasses. Spring applications have shown more promise than applications in the fall. Use of these products for summer fallow is strictly in the experimental phase and is not approved for commercial use.

[1] Industrial and Biochemicals Department, E. I. du Pont de Nemours and Company

THE INFLUENCE OF DOSAGE AND VOLUME OF DILUENT ON 4-CHLORO-2-BUTYNYL N-(3-CHLOROPHENYL) CARBAMATE APPLIED AT TWO GROWTH STAGES TO CONTROL WILD OATS

H. A. Friesen[1]

Hopkins et al. in an unpublished report in 1958 described the preparation and preliminary testing of a compound, 4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate, designated as "Carbyne" which showed selective herbicidal properties when applied to wild oats in cereal grains. The degree of control was conditioned not only by dosage but also by plant age at time of treatment and volume of diluent, water, used in spraying.

In 1958 Carbyne was applied at Lacombe at nil, 4, 8 and 16 oz/A in diluent at 6.5 and 56 gal/A, on wild oats and Olli barley growing in pots in the greenhouse. The wild oats and barley had 1.5 leaves at the time of spraying. The plants were cut, dried and weighed at heading of the barley. In the field, Carbyne was sprayed at nil, 4, 8 and 16 oz/A, in water at 6 and 30 gal/A, at the 1.5 leaves and 2.5 to 3 leaves stages of the wild oats. The wild oats were growing in plots seeded to Thatcher wheat. A triple lattice design with three replications was used. Assessment was by periodic height measure-

ments of wild oats plants, counts of wild oats and wheat plants, the yield of wild oats and wheat at maturity, and the germinability of the wild oats. A similar study was conducted on wild oats growing in plots of Olli barley. In the third trial Carbyne at 8 oz/A mixed with the triethanolamine salt of MCPA at 4 oz/A, all in 5 gal/A of water, was sprayed on wild oats in wheat when the weed reached the 1.5-leaf stage. On one half of the treated area ammonium phosphate 11-48-0 at 50 lb/A was drilled in with the wheat. In a fourth experiment, three varieties of each of wheat, barley, oats, and flax were sprayed with Carbyne at two dosages in 6 gal/A of water at two growth stages. The plots were kept weed-free by hand cultivation. Assessment was by yield of grain and maturity.

1. At the dosages used in these experiments the action of Carbyne on wild oats both in the greenhouse and in the field tended to be one of suppression of growth and development rather than actual killing of the plants. The immediate effect was an arresting of growth. Subsequently, the leaves thickened, turned deep blue-green in color and became necrotic. New leaf and stem initials were in evidence three to four weeks after treatment.

2. Carbyne was applied at nil, 4, 8, and 16 oz/A. The two heaviest dosages resulted in the greatest reduction in the number of wild oats plants and suppression of growth of the survivors, but the differences between them were small (Table 1). Carbyne at the 4 oz/A rate resulted in only a temporary suppression of wild oats, but if applied when they had only 1.5 leaves, it resulted in marked increases in the yield of wheat.

3. Plant age and volume of diluent were critical factors in both the greenhouse and field studies. In the field, Carbyne, sprayed in 6 gal/A of water at the 1.5-leaf stage of the wild oats and the 2.5-leaf stage of the wheat reduced the number of wild oats plants by over 30 percent and greatly suppressed their development. This resulted in increased yields of wheat. Later spraying, when the weed had 2.5 to 3.0 leaves and the wheat had 4.0 leaves, resulted in a slightly more severe suppression of wild oat growth but gave little reduction in the number of plants. The heaviest rate of Carbyne, 16 oz/A, sprayed at this time delayed maturity and reduced tillering in Thatcher wheat. When the volume of water was increased to 30 gal/A there was only a very temporary suppression of growth and development at all dosages of Carbyne used. However, the suppression was slightly more pronounced at the heaviest dosage applied at the later stage of growth and may account for the small increase in wheat yields obtained.

4. On soils responsive to phosphorus fertilizers the application of this nutrient enhanced wild oat control with Carbyne.

Table 1. Number and weight of wild oats and wheat (grain) following various treatments with Carbyne. Lacombe, Alberta. 1959

Growth stage wild oats	Rate lb/A	Volume gal/A	Wild oats No. plants	Wild oats Weight lb/A	Wheat No. plants	Wheat Yield bu/A
Mean of untreated checks			351	2420	116	22.8
1-1½	¼	6	360	2190	153	29.9
1-1½	½	6	280	1380	130	26.8
1-1½	1	6	236	1250	102	31.1
1-1½	¼	30	338	2040	111	20.2
1-1½	½	30	332	2370	129	20.9
1-1½	1	30	270	1790	118	21.8
2½-3	¼	6	338	2020	125	26.4
2½-3	½	6	314	1500	128	25.8
2½-3	1	6	286	1130	111	22.2
2½-3	¼	30	294	2310	121	21.1
2½-3	½	30	367	2460	106	25.9
2½-3	1	30	336	2090	110	27.6
L.S.D. P = .05				663		6.3
.01				893		9.3

5. Barley infested with wild oats reacted to Carbyne similarly to wheat. Natural variability in the wild oat population distorted the barley yields.

6. Barley, wheat, and flax varieties were more tolerant to Carbyne at the 2.5 leaf stage than at the 4.0-leaf stage. Varietal differences were noted depending on plant age and dosage. All oats varieties were extremely susceptible.

7. Carbyne treatments produced no effect on the germinability of mature wild oats seeds.

[1] Experimental Farm, Lacombe, Alberta

DELAYED SEEDING FOR WILD OATS CONTROL

N. A. Korven[1]

A cultural experiment for wild oats control was conducted on a heavy clay soil that was seriously infested. The effect of four fallows and four seeding treatments on the wild oat population in the top 5 inches of soil was studied. Soil samples were taken in the fall of 1955 before any cultural work was done and again in the fall of 1957 after the crop was harvested.

The fallow treatments were: (1) Fall disk, and standard fallow; (2) Fall spray and disk and standard fallow; (3) Standard fallow; (4) One standard fallow plus spray and disk. The herbicide sprayed was 10 lb/A of IPC. The seeding treatments consisted of early (May 1) and delayed (May 23) seeding of wheat and barley.

The data on soil populations of wild oats seeds revealed that early seeding resulted in an increase as high as 518 percent or five times the original infestation. Delayed seeding, on the other hand, reduced the population as much as 66 percent. The fall disking resulted in higher emergence of wild oats the following spring and the standard fallow had a significantly higher final population than the other fallow treatments.

Plant counts of wild oats in the crop revealed early seeding had a significantly higher infestation than delayed seeding. Standard fallow had a significantly higher infestation than the other fallow treatments.

[1] Experimental Farm, Swift Current, Sask.

AN EVALUATION OF 2,6-DICHLOROBENZONITRILE AS A CONTROL OF WILD OATS AND OTHER SPECIES

E. S. Hagood[1]

2-6-Dichlorobenzonitrile is a new herbicide, discovered by Dr. H. Koopman and Mr. J. Daams of the N. V. Philips-Duphar of the Netherlands, of which details will soon be published in "Nature." During the past year its performance has been studied by the Research and Development Department of the Niagara Chemical Division. 2,6-Dichlorobenzonitrile is a white crystalline solid with a melting point of 114°-144° C. Its solubility in water at 25° C is 10 parts per million. It is partially soluble in organic solvents.

It was used in wettable powder formulation. Five experiments were completed during 1959 at a single location in Western New York upon a Dunkirk silt loam. Prior to the establishment of each test, the following seeds were broadcast and disked in: crabgrass, foxtail, barnyardgrass, pigweed, and wild mustard. These seeds were in addition to the normal weed seed load of the soil. The five experiments included two pre-planting, soil-incorporated tests, two pre-emergence tests, and one post-emergence test.

The herbicides were applied at a pressure of 35 psi and a volume of 70 gal/A by a tractor mounted sprayer. Immediately after application in the pre-planting tests, the herbicides were rototilled into the upper inch (Test 1) or 1½ inches (Test 2). During the early part of the season the weather was normal, but hot, dry weather occurred during July to September, and three irrigations were applied. Performances were determined by plant counts, vigor ratings, and observations.

Wild oats, *Avena fatua*, were planted 1, 2, and 3 inches deep in the first pre-planting test. In the second test, the wild oats were planted 2, 3, 4, 5 and 6 inches deep. Screen wire packets, each containing approximately 700 wild oat seed, were also planted at the 2 through 6 inch depths.

In the first pre-emergence test, wild oats were planted 1½ inches deep. Two rows of wild oats, one 2 inches and the other 5 inches deep, were planted in the second pre-emergence test.

Sixteen crops were planted and treated in these tests. A second paper (Page 00) reviews the performance of 2,6-dichlorobenzonitrile as an herbicide and its safety in these crops.

2,6-Dichlorobenzonitrile, dalapon, IPC, and EPTC were compared as pre-planting herbicides. On May 29, 21 days after treatment, the 4 lb/A rate of 2,6-dichlorobenzonitrile had effected the best controls, 98.1% control of the wild oats and 98.4% control of other annual grasses and broadleaved weeds. One lb/A of 2,6-dichlorobenzonitrile and 6 lb/A of EPTC were comparable in over-all controls. IPC and dalapon at 6 and 8 lb/A, respectively, were markedly less effective than 1 and 4 lb/A of 2,6-dichlorobenzonitrile.

Five rates of 2,6-dichlorobenzonitrile were compared as a pre-planting herbicide for the control of wild oats. Wild oats emerged readily from the 6 inch depth of planting in the untreated plots. Based upon counts of emergence in comparison with the untreated, the 2, 3 and 4 pound per acre rates of 2,6-dichlorobenzonitrile "controlled" (without regard to depth of planting) from 91.5 to 100% of the wild oats. (These percent controls are based upon counts, which were made 21 and 36 days following treatments, and upon a 52% germination of the wild oat seed.)

A study of the buried packets of wild oat seed at the 2, 3, 4, 5 and 6 inch levels has indicated a possible mode of action for the 2,6-dichlorobenzonitrile. Only slight reductions in germination (from 46.5% to 37.4%) followed the 4 lb/A application of 2,6-dichlorobenzonitrile. Therefore, this compound did not act as a seed toxicant. Of those seeds that germinated there were striking differences in emergence between the untreated and the treated. At 4 lb/A of 2,6-dichlorobenzonitrile, 0.05% of those that germinated gave rise to above ground shoots. In contrast, 52.3% of those that germinated in the untreated gave rise to above ground shoots.

How did 2,6-dichlorobenzonitrile act to kill the wild oats? The indications are as follows: 2,6-dichlorobenzonitrile is practically insoluble in water. Therefore, it was localized in the band into which it was rototilled. There was ½ inch of untreated soil over the 2 inch packets and 4½ inches over the 6 inch packets. Shoot development appeared to be normal as the shoots grew through these untreated bands. When the shoots from either depth entered the upper 1½ inches of treated soil, they were killed. This necrosis started with the shoot tip.

The following herbicides were applied pre-emergence: 2,6-dichlorobenzonitrile at 1, 2, 3 and 4 lb/A; diuron at 3; CIPC at 6; simazin at 2; and CDAA (Randox) at 6 lb/A. Three and 4 lb/A of 2,6-dichlorobenzonitrile effected better pre-emergence controls than CIPC or Randox. These rates equalled, with the exception of wild oats, the performance effected by simazin and diuron. 2,6-Dichlorobenzonitrile pre-emergence did not control wild oats as effectively as when it was applied pre-planting and incorporated. Even so, 2,6-dichlorobenzonitrile effected markedly better pre-emergence controls of wild oats than either simazin or diuron.

Four lb/A of 2,6-dichlorobenzonitrile pre-emergence controlled the following percents of annual weeds and grasses, when evaluated 10 to 12 weeks after treatment (2 tests): Barnyardgrass, 79; crabgrass, 89; foxtail, 98; wild oats, 85; lambsquarters, 98; mustard, 87; pigweed, 99 and purslane, 88. All annual broadleaved weeds and grasses were controlled 95% and 89%, respectively.

[1] Niagara Chemical Division, Food Machinery and Chemical Corporation, Research and Development Department.

RAILROAD AND INDUSTRIAL WEED CONTROL USING AMITROL WITH SEVERAL STANDARD RESIDUAL HERBICIDES

Roy R. Johnson[1]

When working with residual herbicides such as monuron, diuron or simazin many weed workers have found that less material is required to keep ground free of weeds than is necessary to remove existing vegetation. As a result most residual materials are put on prior to weed growth. When they are put on in post-emergence sprays, they are often combined with other chemicals which control existing vegetation. Four years of tests have indicated that amitrol is very satisfactory for use in combination with monuron, diuron, or simazin. It controls a wide spectrum of grass and broadleaf weeds. Its rapid translocation into perennial weeds gives control before root absorbed chemicals leach into the root zone. In addition, in areas where vegetation does not begin to grow until rain falls, treatment can be delayed until weeds are up. By applying amitrol combinations after heavy spring rains have brought on a flush of weed growth, it is possible to obtain acceptable weed control with less material than is required in pre-emergence treatments.

In an attempt to reduce costs while maintaining or improving the beauty, utility and safety of the highways, the various states are relying more and more on chemical maintenance. For example, the New York State Department of Public Works has found that it gets two seasons of control from applications of amitrol with monuron or simazin to highway guardrails. In some sections annual grasses invade the treated area during the summer of the second year. These are cleaned up with dalapon-2,4-D or amitrol. New York is currently using 3 lb/A amitrol + 8½ lb/A simazin or 3½ lb/A amitrol + 12.8 lb/A monuron as well as 10/A of simazin or 16 lb/A of monuron alone.

In Minnesota 16 lb/A simazin and a combination of 12 lb/A simazin and 4 lb/A amitrol gave 85% and 95% control respectively of guardrail vegetation at 2 locations in 1958. In September 1959, the simazin-amitrol plots still showed 95% weed control while simazin alone gave 80% control. Foxtail had invaded the plot treated with simazin at 16 lb/A.

In Connecticut and California directed applications of 1 lb/A amitrol + 3 lb/A simazin were made to weeds in highway median strip shrub plantings. The California application was made in January 1959 and was still giving 80% weed control as of November 1959. These plots showed no damage to ornamental shrubs including *Juniper* spp., *Pyracantha* spp., *Pinus ponderosa*, oleander, *Euonymus* spp., and *Ceanothus* spp. The Connecticut test was applied in May 1959 and gave weed control throughout the summer with no damage to hawthorne or multiflora rose. The Connecticut Department of Highways made additional applications to median plantings throughout the summer.

Economical maintenance of ballast is also a major problem for railroads. While the use of chemicals is not

new to railroads, this very use of chemicals has created new problems. Resistant perennial weeds such as milkweed, horsetail, Canada thistle, and bouncingbet, have become established on ballast areas where competition from annuals has been reduced or eliminated. Combination treatments are an answer to this problem of resistant weeds. In combination, amitrol is an efficient herbicide for controlling these and other problem weeds.

A railroad yard weed control application using off-track equipment was made in Kentucky in 1958. The combination of 4 lb/A amitrol + 16 lb/A monuron or diuron kept these yard areas free of weeds during the 1958 season. Four lb/A amitrol + 8 lb/A simazin was satisfactory in 1958 but less effective than amitrol with monuron or diuron. In 1959, however, this simazin-amitrol plot gave 95% control of vegetation, while weed control with amitrol-monuron or amitrol-diuron had fallen off. A commercial on-track application of 8 lb/A monuron plus 2 lb/A amitrol in Nebraska in 1958 gave satisfactory seasonal control of vegetation.

Large scale applications of amitrol combinations were made in July 1959 to the Wabash Railroad in central Missouri, when vegetation was mature and in a semi-dormant condition due to drouth. A prolonged drouth followed and very poor weed control was attained. Crabgrass was the principal weed not controlled. These results indicate that for best results application should be made to young actively growing vegetation.

Based on the aforementioned tests, and many other small scale tests the following recommendations for amitrol combinations can be made:

1. Where valuable trees or shrubs grow near treated area, or for weed control in ornamental plantings use amitrol-simazin.
2. Where perennial grasses are the major problem use amitrol, monuron or diuron.
3. Apply to young actively growing weeds.

[1] Research Department, Amchem Products, Inc., Ambler, Pennsylvania.

PROGRESS REPORT ON "DYBAR" FENURON WEED AND BRUSH KILLER

Florian J. Otto[1]

From observation of test plots in the North Central area, several factors must be considered in the effective use of "Dybar" fenuron weed and brush killer. In light sandy soils the low range of dosage recommendation has been doing an excellent job of brush control. As we move onto heavier, tighter soils, the high range of the dosage recommendation is required to obtain comparable brush kill. Where pellets are exposed to direct action of rainfall, three to eight inches of overhead moisture should give virtually complete disintegration.

Penetration is much faster on porous, well-drained soil surfaces than on heavy soils which flood easily. However, pellets which are protected from direct rainfall action by overhead foliage or trash may take much more rainfall for complete breakdown. Late winter and early spring, when rainfall is generally more abundant, is the preferred time for application, although applications at other times of the year are eventually satisfactory.

Twenty-two species are listed on the label as being controlled by "Dybar". Some species, such as sassafras, white ash, tulip poplar, etc., appear to be slightly more tolerant of "Dybar" than those species listed on the label. However, rates at the upper level of the label recommendation appear very promising on some of these species.

It appears that response of brush will be similar, whether treating uncut stands or resprouts from recently cut brush. Susceptible species have usually been killed the year of treatment. Sometimes a plant may leaf out and then defoliate several times before it eventually dies. Herbicidal effects on some species have been noted as long as 40 months after treatment, especially where low dosages were used. Terminal growth is usually greatly inhibited as soon as the first symptoms begin to show.

[1] Development and Service Representative, Industrial and Bio-Chemicals Department, E. I. du Pont de Nemours and Company.

BRUSH CONTROL WITH DYBAR (25% FENURON)

L. Playfair[1]

In an experiment to determine if Dybar would control woody growth in Manitoba and, if so, the optimum rate and time, 4 plots located 15 miles northeast of Winnipeg, were treated in early June, 4 more in mid-July and 4 in mid-September. Rates used were 16, 32, 48 and 64 lb/A of the commercial material. Plots were 1/32 of an acre in size. The soil is sandy loam and growth consisted of aspen and balsam poplar, chokecherry, hazelnut, saskatoon, burr oak and hawthorne. The Dybar, in pelleted form, was broadcast by hand, the only practicable method as the brush was quite thick.

Observations in mid-July of the June treated plots and in mid-September of the June and July treated plots indicated that the rates of 48 lb/A and 64 lb/A might give good control and the lower rates were having some effect on the growth. Final observations will not be possible until next summer.

Of interest was the effect noted on trees several feet outside of the plots. Poplars, as much as 20 feet away, but apparently with roots in the plots, were dying. A narrow brush-free, grassed strip ran through each plot and the higher rates of Dybar had severely damaged the grass and the lower rates were also causing some damage.

Contributing to what the observers felt was a quick showing of effect on the brush was the relatively high rainfall in the area.

[1] Manitoba Power Commission, Winnipeg.

ADDITIONAL OBSERVATIONS ON THE CONTROL OF WOODY PLANTS WITH PELLETED HERBICIDES[1]

J. W. Herron[2]

The use of pelleted fenuron for brush control first reported at the 1958 NCWCC was continued in 1959. Observations were made on plots treated in 1958. This year the program was extended to include treatments on other types of soil as well as different formulations of fenuron and the dimethylamine salt of 2,3,6-TBA [trichlorobenzoic acid 24.8% — polychlorobenzoic acids 1.3% (DuPont)]. Another objective of these experiments was to evaluate the use of pelleted and granular herbicides from the standpoint of conversion of hardwood stands to pine plantings for pulpwood and Christmas trees; representatives of the Forestry Section of the

University of Kentucky are cooperating in this part of the study.

On September 10, 1959 ratings (Table 1) were made on plots treated broadcast by hand with fenuron pellets on March 12 and April 1958, at rates of 6 to 18 lb/A. Plot size was 400 square feet.

Table 1. Brush control ratings* made 9/10/59 on plots treated in 1958

Rate fenuron lb/A	Applied 3/12/58	Applied 4/9/58
6	4	
8	4	
10	8	
12	8.5	
14	8.5	5.0
16	8.5	7.0
18	8.0	8.0

* 1 = No visible effect 10 = Complete top kill

Results from rates of 10 to 18 lb/A were comparable, very little variation in plant kill being observed. Since symptoms of the fenuron treatments were still apparent in some plants that were not dead the second growing season, further observations will be necessary next year. Ground cover of both grasses and broad-leaved weeds was present on all treated plots. By September 10, 1959 volunteer Virginia pine seedlings 10 to 12 inches high were present on plots treated in 1958 with fenuron at rates of 10 to 18 lb/A. No symptoms were noted in any of the pine seedlings.

In 1959 fenuron, 2,3,6-TBA, and a combination of fenuron and 2,3,6-TBA (1:1 ratio) were broadcast by hand in mixed hardwoods on 1/40 A plots on heavy clay soil at 5, 10, and 15 lb/A on May 5 and May 29. On May 19 fenuron pellets were applied on sandy loam soil on 1/10 A plots at 10, 15, 20 and 25 lb/A. Ratings of top injury or kill were made on September 8 and 9, 1959. Within 60 days after treatment there were more than 7 inches of rainfall on the heavy clay area and approximately 3½ inches on the sandy loam area. Treatments applied May 4 at rates of 10 and 15 lb/A were more effective than those made on May 29. In general, treatments on sandy loam soil were more effective than the same treatments on heavy clay.

Results of these experiments can be summarized as follows:

1. Soil type influences the rapidity of effectiveness of fenuron during the first growing season following spring applications.
2. More than 10 lb/A of fenuron may be necessary to give satisfactory control of some hardwoods.
3. Similar results were obtained with 25% or 50% formulations of fenuron.
4. Fenuron and a combination of fenuron and 2,3,6-TBA were more effective than 2,3,6-TBA, which was relatively ineffective.
5. On heavy clay soil, applications of fenuron on May 4 were more effective the first growing season than applications made on May 29.
6. Symptoms of fenuron applications greater than 10 lb/A were still apparent in many species that were not completely dead two growing seasons following application of the treatments.
7. Although ground cover on some plots was reduced, herbaceous plant growth was present in all plots 4 months after the herbicides were applied.
8. Plants that appeared to be most resistant to fenuron were: sassafras, white ash, black walnut, mountain laurel, and flowering dogwood.

[1] The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published with the approval of the Director.

[2] Department of Horticulture, University of Kentucky, Lexington.

FIELD INVESTIGATIONS WITH UROX® AND URAB[1] WEED KILLERS

Roger L. Pierpont[2]

Field tests conducted during the past several years at locations throughout the United States and Canada show that Urox, 3-(p-chlorophenyl)-1,1-dimethylurea trichloroacetate, and Urab, 3-phenyl-1,1-dimethylurea trichloroacetate, are effective non-selective soil-sterilant herbicides for the control of broadleaf weeds, grasses and woody plants.

Urox (formerly GC-2996) and Urab (formerly GC-2603) Weed Killers eradicate plant growth and maintain weed-free conditions for extended periods. The granular formulations contain 22% of the active ingredients, and the liquid formulations are both oil soluble and water emulsifiable concentrates containing 3 lb/gal of Urox or Urab.

In most areas, minimum dosages of 100-150 lb/A of Urox 22 Weed Killer or equivalent Urox Liquid Concentrate provide practical weed control for one normal 5-6 month growing season, but higher dosages are necessary to control deep-rooted perennial plants, and to obtain satisfactory soil-sterilant results for extended periods.

Late summer treatments in the Northeastern United States gave excellent initial effectiveness at 100 lb/A of Urox 22, and rates of 200 lb/A and up exhibited outstanding residual activity throughout the second season.

Tests by the Association of American Railroads[3] obtained excellent control of most weeds for two growing seasons with not less than 125 lb/A of Urox 22. Repeat treatments over a 2-year period wherein a minimum of 160-175 lb/A of Urox 22 was applied (e.g. 100 lb/A the first year and 60-75 lb/A the second year) resulted in controls upwards of 95 per cent. One 200 lb/A treatment kept the entire area 99 per cent free of growth for two years. Urox has been used successfully on all types of sites where an effective soil sterilant is required.

Urab is effective in the control of brush, trees and cattails; it is effective in the control of grass and broadleaf weeds where temporary soil-sterilization is desired, and it shows promise as a selective herbicide for use in certain crops. Urab controls plants more rapidly but for shorter periods in light sandy soils than in heavy clay soils, and it is effective longer in areas of moderate or low rainfall than in areas of high rainfall.

Urab 22 Weed Killer applied 6-12 inches from the base of brush, and Urab Liquid Concentrate injected undiluted 6 inches deep into the soil at the base of the brush or diluted 10 per cent by volume with water (3% actual Urab) and applied as a basal spray, eliminated all brush regrowth 5-6 feet in height without excessively damaging herbaceous ground cover in Tennessee. Rates of 16-21 lb/A of actual Urab have given complete control of brush, and control at lower rates is indicated.

As a temporary soil-sterilant, Urab appears to penetrate the soil more rapidly than certain other soil-sterilant herbicides and reach the root zone of the plants quicker, resulting in faster kill of deep-rooted perennial weeds and brush. This faster rate of travel through the soil reduces the period of soil sterility and permits seedling growth or the growth of crop plants within a period of 5-12 months. Where longer control of plant growth is desired, additional low dosages of Urab are effective.

Urab Liquid Concentrate at 4-5 gal/A appears to be very effective for control of cattails in drainage ditches. Best results are obtained when the foliage is mature. In a pink bollworm eradication program in Florida, 200 pounds per acre of Urab 22 effectively controlled wild cotton. Limited tests with Urab on row crops indicate that effective weed control is obtained with pre-emergence applications of 0.5 to 3 lb/A of Urab. The most

XUM

promising results are in controlling weeds in asparagus, corn, cotton, onions, potatoes, pineapples, and sugar cane.

[1] Trade mark of Allied Chemical Corporation.
[2] General Chemical Division, Allied Chemical Corp., New York, New York.
[3] Report of Committee 1——Roadway and Ballast, Am. Railway Engineering Assn., Bulletin 549, Feb. 1959.

INDUSTRIAL WEED CONTROL WITH HCA[1] IN COMBINATION WITH OTHER HERBICIDES

Roger L. Pierpont[2]

The systemic effect of HCA, a herbicide based on hexachloroacetone, as an additive in cotton and non-crop sites was demonstrated by H. E. Rea[3] at College Station, Texas in 1953, 1954, and 1955. HCA increases the initial and residual effectiveness of oil sprays against Johnsongrass, nutgrass and other grasses and broadleaf weeds, but because its potential in oil appears limited to certain uses where a quick burn back of weeds is desired, and where control of grassy weeds is the main object, addition of other herbicides particularly effective against broadleaf weeds is indicated in industrial situations where general non-selective weed control is the object.

HCA was combined with a number of herbicides and tested on a complex of broadleaf weeds, grasses and woody plants. Tests to date show that herbicides formulated so as to be miscible or dispersible in oils, such as diesel fuel or kerosene, can be applied satisfactorily in HCA-oil sprays where oil is the sole carrier. Some herbicides, formulated primarily for application in water, can also be added and applied satisfactorily in HCA-oil sprays. For example, the water dispersible monuron formulation (Telvar W) can be dispersed in HCA-oil sprays with moderate agitation and successfully applied if concentration of monuron added to the oil does not exceed suspensibility limits.

Certain HCA herbicide combinations were applied June 2 to June 5, 1959, in kerosene to total 150 gal/A of spray, to established mixed broadleaf weeds and grasses on a railroad right-of-way. The results, which are typical, follow:

Table 1: HCA plus other herbicides.

HCA, gal/A formulation	Other herbicide, lb/A		Percent top growth reduction 6/11	6/26	7/13	8/3	9/1
2.25	———	—	70	80	60	60	30
——	2,4-D[a]	6	80	60	60	40	0
2.00	2,4-D[a]	6	85	99	95	90	80
——	2,4,5-T[a]	6	95	95	75	75	60
2.00	2,4,5-T[a]	6	95	99	95	85	85
——	2,4-D+ 2,4,5-T[a] (1:1)	6	95	95	75	75	60
2.00	2,4-D+ 2,4,5-T[a] (1:1)	6	100	99	99	99	95
——	PCP	10	100	98	80	55	35
2.00	PCP	10	100	99	99	95	90
——	Telvar W	6.25	85	90	70	90	60
2.00	Telvar W	6.25	100	99	98	98	95

[a] 2,4-D and 2,4,5-T as butoxyethanol ester.

These data show that HCA improves the general non-selective weed control desired in non-crop areas of a number of herbicides which at low and economical dosages are not usually satisfactory alone or with kerosene. Where long-term residual control is the object, a combination of HCA and Telvar W is most effective. If one or more resistant broadleaf species are present, addition of 2,4-D, 2,4,5-T or mixtures thereof are preferred. Pentachlorophenol has a long history of effectiveness in oil sprays, and the addition of HCA appears to accentuate its effectiveness.

HCA was used in combination with tris (2,4-dichlorophenoxyethyl) phosphite (Falone), CDAA (Randox), simazine, and erbon (Baron). Effective control of weeds in non-crop areas appears to be economically feasible through the use of such combinations, and many varied industrial uses appear practical. The results follow:

gal/A HCA, formulation	Herbicide, lb/A		Diluent, to total 150 gal/A of spray	Per cent top growth reduction 1 mo.	2 mo.	3 mo.
—	Falone	10	Water	15	15	0
2	Falone	10	Kerosene	99	99	95
—	Randox	4	Water	0	0	0
2	Randox	4	Kerosene	95	90	85
—	Simazine	3	Water	0	0	0
2	Simazine	3	Kerosene	95	95	90
—	Baron	12	Water	40	20	10
2	Baron	12	Kerosene	98	99	95
—	———	150 gal	Kerosene	30	0	0

Preliminary tests with granular and water emulsifiable HCA formulations indicate that they are not as effective in combination with other herbicides as the HCA-oil formulations, but the results are promising and additional work is in progress.

In order for HCA herbicide combinations to exhibit maximum effectiveness, in addition to the use of proper dosages, the use of a coarse spray with adequate pressure to drive the chemical to the crown and root zone of the plant is recommended, and enough diluent to insure complete coverage is a necessity.

[1] Trade mark of Allied Chemical Corporation.
[2] General Chemical Division, Allied Chemical Corp., New York, New York.
[3] H. E. Rea. Spot-spraying Johnsongrass. Texas Agri. Expt. Sta. Bul. 902. 1958.

PRELIMINARY OBSERVATIONS ON THE USE OF SILVEX GRANULES FOR BRUSH CONTROL ON RIGHTS-OF-WAY

H. F. Hilton, E. J. Haertl, J. H. Davidson[1]

The recent increase and interest in the use of granular herbicides has resulted in more widespread applications for vegetation control. One of the principal areas of investigation is brush control on utility rights-of-way. Silvex ester[2], formulated in an emulsifiable form, has been used successfully in spray applications for the control of several species of brush[3]. It has also been reported[4] that silvex has soil residual properties superior to 2,4-D. Soil spray applications have shown promise in control of lateral root sprouting species such as locust.

A series of two-acre plots on a right-of-way of the Public Service Company of Indiana were treated with granules containing 20% silvex in comparison with a basal application of 2,4,5-T ester in oil. The treated plots were approximately 150 x 600 feet. The growth consisted of native deciduous trees and shrubs. The soil is a rather heavy clay with fairly high moisture. With fairly uniform dispersion at 100 lb/A, about 50-60 granules were applied per sq ft. The application used five men on the 150-foot right-of-way. The men were spaced about 35 feet apart with the two end men about 10 feet inside the boundary lines. The center man led the way, broadcasting about at a 45° angle to either side of the centerline. The next two men followed about 20 feet behind and broadcast in a similar pattern. The two

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end men broadcast straight ahead and at 90° toward the inside of the right-of-way, producing a reasonably uniform coverage.

Treatment before cutting. The first plot was treated Nov. 18, 1958. Clearing was done in January, 1959, and first observations were made in mid-June. Moving logs after cutting disturbed the soil and reduced growth of ground cover. Some regrowth was observed on maple, oak, ash, beech, sassafras, elm, and gum, but growth appeared considerably less vigorous than that on the plot which received basal 2,4,5-T ester in oil. Many shoots showed systemic effects, such as cupping and drooping of leaves, reduction in leaf size, abnormal color, marginal distortion, cracking of stems and some proliferation. Poison ivy, which formed a good part of the ground cover, showed systemic effects. In mid-October, there was some regrowth of the tree species mentioned; the shoots were not as large or vigorous as those on the 2,4,5-T plot. Sassafras, ash, maple, and gum still showed some symptoms of herbicide action. Poison ivy had practically disappeared and the ground cover consisted primarily of seedling weeds.

Treatment after cutting. The second test plot also was cleared in January, 1959; the granular silvex was applied March 18. Rainfall after this date was: March, 0.52″; April, 2.3″; May, 3.9″; June, 2.9″; and July, 4.5″. In mid-June the ground cover on this plot was negligible. Systemic effects were noted on shoots. The amount of regrowth was considerably less than the treatments made before cutting. The stumps under 8 in. diam. showed very little shoot growth. Some shoots of sassafras clearly showed systemic effects. In mid-October, there were few shoots present, and on those there was definite systemic activity. This was true of oak, maple, sassafras, elm, and gum. It was difficult to find any seedling sassafras or locust, which are usually early invaders. There was a much heavier ground cover of weeds and grasses.

Some preliminary conclusions are suggested by these tests and other observations:

1. Preliminary results indicate considerable promise in the use of granular silvex ester. This requires much higher rates of silvex than are normally used in foliage sprays for brush and weed control.
2. It appears that spring applications are quite effective.
3. It will require two or more years after treatment to evaluate the use of granular herbicides for brush control.
4. Observations point to a residual effect of silvex when applied to the soil.
5. The hazard of drift and root absorption outside the treated area is low when using granules of low volatile silvex ester.

[1] The Dow Chemical Co., Midland, Michigan.

[2] Kuron—Containing a low volatile silvex ester, manufactured by The Dow Chemical Company.

[3] Darrow, R. A. Control of post and blackjack oaks by aerial spray applications of herbicides. Proc. SWC 9:109. 1956.

[4] Silvex Technical Bulletin No. 1. Pre-emergence weed control. The Dow Chemical Company. 1954.

USE OF HERBICIDES IN THE IMPROVEMENT OF MARSH HABITAT FOR WATERFOWL ON NATIONAL WILDLIFE REFUGES IN THE NORTH CENTRAL STATES

Clair T. Rollings[1]

Approximately ½ million acres of marshland are managed for the benefit of waterfowl on national wildlife refuges in 11 north central states. Marshland having highest waterfowl value must produce the right combination of food and cover plants and have a good interspersion of open water areas and emergent vegetation. Northern breeding marshes must have the proper type and density of shoreline vegetation to attract waterfowl breeding pairs. Maintaining marshlands in optimum condition for waterfowl use is a challenge in habitat management. A variety of management tools is employed for control of vegetation on marshlands including manipulation of water levels, grazing, controlled burning and cultivation. Herbicides have been used for vegetation control since 1954.

Vegetation control on marshes in the north central states falls largely into two categories: (1) creating openings in dense shoreline vegetation and (2) breaking up dense monotype stands of cattail, phragmites and other emergent species.

At Lower Souris Refuge in North Dakota, soil sterilants were used on dense, tall shoreline vegetation to create openings or "loafing spots" used by breeding pairs of waterfowl. Principal species treated were cattail, phragmites, river bulrush, hardstem bulrush, *Carex spp.*, and bur-reed. Ureabor (a BMM, monuron 4% boron trioxide 41.5%) applied on moist soil or in water a few inches deep at 872 lb/A in August, 1956 gave a near complete kill through the 1959 growing season on all species treated. Observations indicate these "loafing spots" may remain open and usable to breeding pairs for another season or two. The cost of the Ureabor was about $4.13 for each loafing spot (appx. 20′ x 30′) or $299 per acre.

Erbon (Baron) applied at 174 lb/A on cattail, phragmites, river bulrush, *Carex spp.*, soft-stemmed bulrush, whitetop, and sandbar willow in July, 1958 gave a near complete kill through 1959. Even the hard-to-kill species, river bulrush and *Carex*, were 99% and 100% dead. The cost of the Baron was about $3.73 for each loafing spot (appx. 20′ x 30′) or $270 per acre.

Assuming the need for about 50 loafing spots per mile of shoreline costs were projected on this basis. Using Baron initially at 174 lb/A with a light retreatment of 28 lb/A every two years, the total cost of improving and maintaining a mile of shoreline for breeding waterfowl for ten years would be about $336 or $33.60 per mile per year and $.67 per loafing spot per year. This cost compares favorably with mechanical techniques. Loafing spots created by use of herbicides at Lower Souris, North Dakota, from 1954 to 1959 were well used by breeding pairs, broods and adult waterfowl.

At Mud Lake Refuge, Minnesota, amitrol was applied to an extensive, monotype stand of phragmites in July, 1957 at 4 and 8 lb/A. Water was 0 to 4 inches deep. Two years later no live phragmites was noted in the 8 lb plot, but a few had appeared in the 4 lb plot.

At Sand Lake Refuge, South Dakota, amitrol and Amitrol T (amitrol plus ammonium thiocyanate) were applied to phragmites on semi-dry soil in August, 1958. By late 1959 the plots treated with 6 lb/A amitrol showed 75% kill. Amitrol T at 2, 4, and 6 lb/A gave 98, 100, and 100% kill, respectively. Amitrol T at 4 lb/A would cost approximately $16.20 per acre including $1.00/A for aeroplane. No adverse effects on *Lemna, Potomogeton*, or several other food plants were noted.

Monotype cattail, standing in water up to 12 or more inches deep, was reduced 75% in 13 months at Seney Refuge, Michigan, by applying 64 lb/A of dalapon. A pronounced increase in *Lemna, Potamogeton, Polygonum* and other good duck food plants was noted in the deeper water plot.

Other trials with these herbicides at other refuges were also successful.

Numerous herbicides have been tried on a wide variety of vegetation. Many have proved ineffective. A few look promising. Herbicides will serve as a valuable supplement to more conventional techniques for controlling marsh vegetation on national wildlife refuges in the north central states.

[1] U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Minneapolis, Minnesota.

THE ROLE OF HERBICIDES IN ESTABLISHING CONIFEROUS PLANTATIONS

H. J. Hovind[1]

The removal of competing vegetation prior to planting is necessary for the establishment of coniferous plantations in Wisconsin. Grasses, in particular, rob the trees of soil moisture and nutrients and may spell the difference between success and failure. Exposed mineral soil conditions must be maintained during the first growing season at least—a long period would be desirable but usually is not feasible. Only under the most favorable conditions of light ground cover is it possible to plant trees successfully without first removing or destroying the vegetation where the trees are to be planted.

Competing vegetation is now removed by plowing furrows with a tractor and plow or with scalpers attached to a planting machine. Occasionally the job is done by hand, but 90% or more of the forest trees planted in Wisconsin are put in with planting machines having scalper attachments, or hand planted in furrows.

Following the successful use of herbicides in the establishment of game food patches, it became apparent that this technique could be applied to the preparation of tree planting sites. A chemical means of controlling vegetation would have advantages over mechanical methods. Chemical "scalping" will: 1. Permit easier access for administration; protection, 2. Create less disturbance; furrowing disturbs vegetation and stimulates regrowth; 3. Give newly planted trees more benefit of organic matter; 4. Permit planting operations on wetter sites, and on steeper slopes without fear of soil erosion; 5. Be considerably cheaper than hand scalping; 6. Result in less recovery of vegetation during the critical first growing season; and 7. Permit trees to get above competition sooner.

During the spring of 1958, three 2-acre areas were selected for trials of herbicides to eliminate ground cover. The herbicide solutions were applied in bands two feet wide, spaced six feet apart. The tractor pulling the planting machine furnished the power for the spray pump and the entire job of spraying and planting was accomplished in one operation. Very little, if any, spray solution got onto the trees. Approximately 6,000 trees were planted in this manner. In all three areas, simazin, dalapon, and amitrol were applied in various strengths and mixtures.

Results at two sites were inconclusive because of outside influences. The other area was a fertile, light sand soil, with a moderately dense stand of quackgrass which made conventional methods difficult. Red pine *(Pinus resinosa)* two-year seedlings were used in this trial. The results were as follows:

Plot	Treatment lb/A	Per cent grass control 6/20/58	Per cent grass control 8/19/58	Per cent tree survival 8/19/58	Per cent tree survival 7/31/59	Initial growth trees	Thriftiness of living trees 8/19/59
1	Simazin, 3	55	75	75	42	Fair	Thrifty
2	Simazin, 1½	35	60	69	33	Fair	Moderately unthrifty
3	Simazin, 1½ and dalapon, 7½	90	80	87	50	Good	Thrifty
4	Dalapon, 12	100	60	71	7	Fair	Unthrifty
5	Dalapon, 7½ and amitrol, 3	100	55	81	17	Good	Unthrifty
6	Amitrol, 4½	75	45	77	7	Fair	Moderately unthrifty
7	Furrow only	90	60	87	17	Good	Moderately unthrifty
8	Control, no furrow or chemical			21	0	Poor	

Aug 19, 1958, was in the midst of a locally severe drought accompanied by winds sweeping across a broad flat. Rainfall for the year was 10" under the normal annual precipitation of 29". The survival rate fell rapidly in the late fall of 1958. This dry weather created ideal test conditions.

The best initial growth occurred on plots 3 and 7 where new growth averaged 3" or more. The thriftiest looking trees at the height of the first growing season were in plots 5, 3, and 7, in that order. After the drought and following the second growing season, trees in plots 1 and 3 were the thriftiest. The survival checks indicated that both a quick-killing herbicide and one with a long-lasting residual effect would be desirable—a combination of the two would appear to be the best.

Amitrol seemed to have the least harmful effect on the trees, judging by their color and vigor, followed by simazin and dalapon. Dalapon at 7½ lb/A had little effect on the trees but at 12 lb/A showed some needle browning, a slight discoloration of foliage, and stunting of the terminal shoots. Dalapon at 12 lb/A and the mixture of dalapon and amitrol had a sensational killing effect on the quackgrass but did not have much residual effect. Control with simazin did not show up until 5 or 6 weeks after the application; however, its residual effect held for most of the first growing season. On all the chemical plots, the quackgrass recovered completely by the middle of the second season.

A plot was established the spring of 1959 using a mixture of 6 lb/A of dalapon and 6 lb/A of simazin. It is expected that these amounts will give control through two growing seasons or approximately 15 months. Such control would be ideal. The higher rate of simazin increases the cost per acre but the cost can be reduced by applying the chemical in narrower bands. Initial results from trials of the use of herbicides to control vegetation while establishing forest plantations appear promising. It is expected that selected herbicides will provide an effective substitute for mechanical control of vegetation.

[1] Wisconsin Conservation Department, Tomahawk, Wisconsin.

CHEMICAL SITE PREPARATION AND MAINTENANCE FOR CORN AND SHRUB PLANTINGS TO IMPROVE WILDLIFE HABITAT

R. G. Heath[1]

Improving wildlife habitat by adding desirable game food and cover has become an important part of many state game management programs, and corn food patches and shrub and evergreen plantings are widely used and accepted in this work. Corn is a preferred food of probably more game species than any other item, and shrubs and evergreens can often furnish food in addition to excellent protective cover.

In southern Michigan alone the Conservation Department's Game Division plants over 1,000 acres of corn and 1,500,000 pines and shrubs annually, where public hunting areas could not otherwise sustain game numbers adequate for the heavy hunting pressure they receive. Currently mechanical tillage is a major expense in establishing these plantings. We hope to find herbicides that will reduce tillage costs by either completely replacing mechanical tillage or at least mechanical cultivation.

Chemical tillage for corn food patches. Our earliest trials of "complete chemical tillage" for corn (1955) tested May applications of 3 rates of dalapon on sod burned in April, followed by a spray of 2,4-D a few days after corn emergence. We began simazin tests on corn in 1958, at which time we applied it successfully as a pre-emergence spray on fitted ground to eliminate mechanical cultivation. In 1959 we began tests of simazin in "complete chemical tillage" for corn.

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Chemical tillage for shrubs and evergreens. Chemical tillage for woody plantings is complicated by the necessity of planting during the "dormant" period when foligae herbicides are least effective. Thus to avoid planting stock injury, most foliage herbicides must be applied in advance of planting, and none tested to date have compared favorably with mechanical tillage. Selective surface-type herbicides such as simazin seem a logical solution, and tests with this chemical, though less than a year old, are so far successful. Established alfalfa and milkweed seem highly resistant to simazin, and although usually avoidable, should be considered in locating planting sites.

Summary

1. Two and 4 lb/A pre-emergence simazin sprays on fitted soil effected corn yields equal to mechanical tillage. A 5 lb/A application on quack grass produced corn where previous attempts with mechanical tillage had failed.

2. We produced high corn yields per stem (though seeding was somewhat erratic) by a 3-step procedure:
   (a) burn field trash in early spring,
   (b) spray 3 lb/A of simazin within 3 days after burning, and
   (c) drill corn into the dead sod at normal planting time.

3. Limited observations suggest that burning may not be necessary in the above method if simazin is applied in very early spring (late March or early April).

4. First-year growth of honeysuckle, multiflora rose, and silky dogwood planted in fitted soil treated with a pre-planting spring spray of 2 lb/A of simazin was equal to growth of plants receiving mechanical cultivation.

5. Four lb/A of simazin applied as an 8 per cent active granule in mid-May of 1958 on a quack-bluegrass complex produced no visible effect that summer, but gave good control the year following application (1959). This rate applied as a spray at the same time on a similar site produced practically no effect either year.

6. Results with simazin have been encouraging enough to warrant limited management trials in 1960.

[1] Michigan Department of Conservation, Lansing.

CHEMICAL WEED CONTROL IN WINDBREAKS

W. T. Bagley and R. T. Miyoshi[1] [2]

Adequate cultivation is necessary to obtain good tree survival and growth in the Great Plains. Weed control immediately adjacent to the trees requires special effort and special equipment. Survival and growth is better if the tree rows are free of weeds during most of the growing season. Soil sterilant herbicides may help solve this problem.

Farmer cooperation permitted herbicide trials on tree plantings to be extended beyond the Experiment Station in 1959. New plantings as well as one and two year old plantings were selected. Soil textures ranged from silty clay loam to sandy loam. Rainfall during the growing season varied generally from 9 inches in western Nebraska to 26 inches in the eastern part.

Treatments consisted of diuron, 4 lb/A, simazin, 4 lb/A, and 2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine (atrazine) 2 lb/A. EPTC was tried, but it could not be worked into the soil in a satisfactory manner, and was dropped. The controls in all but two plantings consisted of observations on plots which received no cultivation in the tree row. Many weed species had commenced growth when herbicides were applied during the third week in May, 1959.

Weed control with diuron, simazin and atrazine was adequate at all locations for the entire growing season. Differences between the three herbicides were not significant except at Horning State Farm, Cass County, where volunteer grain sorghum was a weed. The sorghum thrived in the simazin and atrazine plots which indicates that the chemicals acted as premergence herbicides. Barnyardgrass, foxtails, and large crabgrass encroached upon the treated areas in the simazin and atrazine plots in late July and early August. This was less noticeable in the diuron plots. Rainfall in Cass County approached 26 inches during the period May through August.

Chemical injury to trees was not apparent in one year or older plantings with the exception of the Alda (Hall County) plantation on a sandy loam soil. Survival of *Juniperus virginiana* in the diuron and simazin plots in this planting was lower than the controls. Site predisposed chlorosis was intensified by diuron. *Fraxinus pennsylvanica, Ulmus pumila* and *Eleagnus angustifolia* suffered no herbicide injury and no mortality.

The 1959 tree plantings escaped serious chemical injury with the exception of the Cass and Lancaster County plantings. High rainfall for the season, including 5 inches during the month of June, caused deeper infiltration of the chemicals into the soil at these two locations in spite of a silty clay loam texture. As a result, considerable injury was noted in the diuron treatments of 5 species at Horning State Farm (Table 1). Simazin and atrazine caused less injury. The most serious chemical injury appeared on *Pinus resinosa* in diuron treated plots. The reason in this case may have been the small shallow-rooted planting stock rather than differences in tolerance between species.

Table 1. Results, 1959, Horning State Farm

Species	Average percent survival			
	Cultivated	Diuron	Simazin	Atrazine
Pinus ponderosa	95	80	97	97
Pinus nigra	95	60	83	93
Pinus sylvestris	90	60*	83	83
Pinus strobus	79	50	83	77
Pinus resinosa	73	20*	50	60
Picea pungens	62	57	57	83
Abies concolor	50	67	57	73
Abies balsamea	62	30	83	63
Pseudotsuga menziesii	87	77	70	87
Juniperus virginiana	84	70	73	77

* Significant at 5% level.

In the Lancaster County planting, diuron, simazin and atrazine caused early chlorosis on *Rosa sp. Prunus tomentosa* and *Lonicera tartarica.* The injury to *Lonicera* by atrazine resulted in heavy mortality. Otherwise, all these treatments recovered and made excellent growth.

In three 1959 plantings in central Nebraska, although they received some machine cultivation, no attempt was made to hoe the tree row. Trees in control plots were soon overtopped by weeds. Vigor and growth were impaired, and survival was generally lower in the control plots than in herbicide treatments. Weed competition was more serious in most instances than injury by herbicides.

Often any loss of trees due to herbicides will be offset by a reduction in mechanical injury and death caused by cultivation. This type of injury is very difficult to avoid when trees become obscured by weeds before cultivation is attempted. Soil moisture, often a limiting factor in the growth in the Great Plains, can be conserved by controlling weeds. This is probably the greatest single reason why interest will continue in the use of herbicides in tree plantings.

[1] Department of Horticulture and Forestry, Nebraska Agricultural Experiment Station.

[2] Published with the approval of the Director as Paper No. 1006a, Journal Series, Nebraska Agr. Expt. Station.

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VEGETATION CONTROL AROUND YOUNG APPLE TREES[1]

J. S. Leefe

The object of the experiment was a comparison of chemical and cultural methods of controlling vegetation around young apple trees. The experimental material consisted of 2-year-old Secor trees on Malling I rootstocks, planted in rows 10 feet apart with 5 feet between the trees in the rows. The land was infested with couchgrass. The treatments were replicated 4 times in randomized blocks using 4 trees per plot.

The 6 chemical treatments were as follows: dalapon 7.4 and 14.8 lb/A with and without the addition of dimethylamine salt of 2,4-D 1 lb/A and amitrol 5 and 10 lb/A. The cultural treatments consisted of hand hoeing and mechanical hoeing with a Friday Automatic Rotary Hoe[2].

Treatments were confined to a strip 4 feet wide with the trees in the center. The area between the strips was under clean cultivation. Chemical treatments were applied as sprays, once per season, at the time of apple bloom. Sprays were applied with a hand boom at 30 psi using 50 gal/A of water. The hoeing operations were done 4 times per season which was found to be often enough to keep the treated strips free of weedy vegetation.

The experiment was continued for 4 years at the end of which time the mean tree sizes and three size increases expressed as sq cm of trunk cross section, 1 foot above ground level, were as follows:

Treatment lb/A	Final trunk cross section cm^2	3-year[a] cross section increase cm^2
Dalapon 7.4	7.75	6.1
Dalapon 14.8	9.94	8.1
Dalapon 7.4 lb/A plus 2,4-D 1 lb/A	10.50	8.7
Dalapon 14.8 lb/A plus 2,4-D 1 lb/A	11.80	9.9
Mechanical hoe	14.69	12.8
Amitrol 5 lb/A	15.44	13.6
Amitrol 10 lb/A	16.38	14.3
Hand hoe	18.53	16.4
L.S.D. .05	2.25	2.2

[a] Trunk measurements first made at the end of the first season growth.

After 4 years the chemical sprays had practically eliminated couchgrass from the treated areas. The mechanical and hand hoeing operations kept the couchgrass under control but did not kill it out. When dalapon was used alone a dense growth of broadleaf weeds developed. The addition of 2,4-D to the dalapon made only slight improvement because of the appearance of weeds resistant to 2,4-D. When amitrol was used at 5 lb/A there was fair control of all vegetation and at the 10 lb/A rate control was almost complete.

Tree growth in this experiment appeared to be directly related to the degree of undertree vegetation control with the exception that trees in the mechanically hoed plots did not make as much growth as those in plots treated with amitrol. This difference, although not statistically significant, was consistent in all years. The trees in plots kept free of vegetation by hand were larger and grew more rapidly than those in the other plots although the difference was not large when compared with mechanical hoeing or amitrol treatment.

[1] Contribution of the Research Station, Canada Department of Agriculture, Kentville, Nova Scotia.

[2] Manufactured by the Friday Tractor Co., Hartford, Michigan.

THE RESPONSE OF STRAWBERRIES AND WEEDS TO THE TRIAZINE HERBICIDES

LeRoy Holm, Franklin Gilbert, and Ernest Haltvick[1]

The experiments reported here are concerned mainly with the use of simazin and trietazine (2-chloro-4-ethylamino-6-diethylamino-*s*-triazine) through the bearing year, and with simazin, trietazine, propazine (2-chloro-4,6-bis(isopropylamino)-*s*-triazine); atrazine (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine); ipazine (2-chloro-4-diethylamino-6-isopropylamino-*s*-triazine), Amoben (3-amino-2,5-dichlorobenzoic acid), and Karsil (N-(3,4-dichlorophenyl)-2-methylpentanamide), during 1959. The studies were made on a sandy loam using the variety Sparkle. Initial treatments were made during the last two weeks of May of each year. The experiments were replicated. The principal weeds in the fields were rough pigweed, lambsquarters, field bindweed, and foxtails.

In 1958, simazin was applied in late May at the rates of ½, 1, and 2 lb/A. The following treatments (lb/A) were applied in late May and mid-July: trietazine 2 and 4, Eptam 5 and 10, simazin ½ plus Eptam 5, and simazin ½ plus sesone 6. In another treatment simazin at ½ lb/A was applied in late May, mid-July, and late August. On August 11 only simazin 2 lb/A had reduced the number of runners per plant. On September 3 and October 14 the same treatment reduced the number of rooted runner plants. Weeds were harvested and weighed several times during the season. All treatments except simazin ½ lb/A (one application) gave excellent weed control. Simazin 1 and 2, and trietazine 4 gave serious reductions in yield of strawberries at harvest in 1959. There was a slight reduction in yield where simazin was used three times at ½ lb/A.

In late May of 1959 another experiment was begun using propazine, trietazine, atrazine, and ipazine at 1 and 2, and simazin at ½ lb/A. With the exception of the ipazine treatment, all showed excellent weed control on July 15 and again in late August. Ipazine, atrazine, and propazine injured the crop severely at this stage of growth. There is more to be said of this from later experiments.

In late May of 1959, a third experiment was begun. The following were included:

1. Simazin ⅛ lb/A (at two-week intervals—May 27-September 22).
2. Simazin ¼ lb/A (at two-week intervals—May 27-September 22).
3. Simazin ⅛ plus sesone 2 lb/A (at two-week intervals—May 27 to September 22).
4. Simazin ¼ plus sesone 4 lb/A (monthly).
5. Simazin ½ plus sesone 4 lb/A (May and July).
6. Simazin ½ lb/A.
7. Karsil 3 lb/A.
8. Amoben 3 lb/A.

On August 25 a count was made of the number of rooted runner plants in each treatment. Where simazin was used a 20 per cent reduction in rooting was noted. Karsil was slightly more toxic. Data are not available for the Amoben treatment. The weight of broad-leaved and grassy weeds was taken on July 15 and August 26. At the early date control was excellent in all areas except that simazin at ⅛ lb/A each 2 weeks had allowed much grassy weed growth. Karsil and Amoben allowed no weed growth. At the later date, the simazin treatments were holding the broadleaved weeds but were giving poor grass control. Karsil was showing no weed control. Data are not available for simazin ½ and Amoben 3 lb/A at this date.

Finally, in an experiment begun in mid-August of 1959, several herbicides were applied to first-year beds. Among them were atrazine ½ and 1, Amoben and Karsil at 2 and 4 lb/A. These herbicides provided excellent weed control and there was no observable injury to the crop.

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In summary, these experiments tell us that the triazine herbicides are worthy of our continued interest and attention. Simazin is not tolerated by *Fragaria* at high rates but seems safe in repeated treatments at lower rates. Trietazine seems worthwhile, although a valid comparison with simazin is not available, for so little data is at hand on the former. Atrazine, which is toxic to new plantings, appears very promising in late season. All of the triazines have shown good weed control with the exception that ipazine was rather impotent in these experiments. The tolerance of *Fragaria* for Karsil and Amoben at both early and late season is noteworthy. They provided good control of all weeds. The contact killing effect of an herbicide such as Karsil has long been sought in this crop.

[1] Department of Horticulture, University of Wisconsin, Madison, Wisconsin.

WEED CONTROL IN ESTABLISHING STRAWBERRY PLANTINGS[1]

Delbert D. Hemphill[2]

The control of weeds in the established strawberry planting is a serious problem in Missouri and during the past three years a concerted effort has been made to develop methods of controlling weeds that germinate in late winter or early spring and crabgrass that germinates during the harvest season.

Fall germinating broad-leaved weeds have been controlled very satisfactorily with late fall (early November) applications of 2,4-D and grasses such as cheat and timothy have been controlled by dinitros or CIPC after the strawberry plants were fully dormant.

Viable seeds in grain straw mulches often create a problem but can be controlled readily by CIPC, 2 lb/A, applied on top of the mulch in late winter while the strawberry plants are still dormant.

Species of weeds such as lambsquarters and horseweed germinate early in the spring and create a serious problem during the harvest season.

In the spring of 1957 after mulch removal and growth of the strawberry plants had just resumed, sesone, CDAA, Falone (tris(2,4-dichlorophenoxyethyl) phosphite), simazin, and Trietazine (2-chloro-4-diethylamino-6-ethylamino-*s*-triazine) were applied as sprays. All treatments except sesone resulted in severe injury to the foliage and reduced yields, and sesone did not control crabgrass germination during the fruiting season.

To reduce injury it was decided to delay application until the foliage was more mature and to use granular formulations of herbicides. In early May 1958 as flowering began, granular 2,4-D, 2 lb/A; CIPC, 10 lb/A; CDAA 10 lb/A; Falone, 6 lb/A; and EPTC, 10 lb/A; were applied to a planting of Blakemore strawberries with a Gandy spreader. No injury to foliage or flowers could be detected. Granular 2,4-D appeared very promising because it not only controlled crabgrass germination until the end of the harvest season but it controlled broad-leaved weeds that had germinated ahead of application.

These studies were continued and in early May 1959, granular 2,4-D, 2 lb/A; CDAA, 10 lb/A; EPTC, 10 lb/A; CIPC, 10 lb/A; Falone, 6 lb/A; Neburon, 4 lb/A; and Amoben (3 amino-2,5-dichlorobenzoic acid), 6 lb/A; were applied to Earlidawn strawberries in bloom. Severe injury resulted from 2,4-D and Amoben applications. Yields expressed in 24-quart crates per acre are indicative of the amount of injury: Control, 397; Amoben, 262; 2,4-D, 197; CDAA, 391; CIPC, 402; EPTC, 355; Falone, 413; and Neburon, 407.

To obtain further information on the use of granular 2,4-D at this stage of development of the strawberry plant an application of 2 lb/A was made to a planting of eighteen varieties. Effects on foliage and yields indicate that there is considerable difference between varieties in their tolerance to granular 2,4-D. Dixieland, Dunlap, Earlidawn, Redglow, Robinson and Stelemaster appear more susceptible to injury than Armore, Blakemore, Catskill, Fairfax, Jerseybelle, Premier, Pocahontas, Red Star, Sparkle, Starkrimson, Surecrop and Tennessee Beauty.

These studies emphasize the need for additional information and this work will be continued.

[1] Contribution from the Missouri Agr. Exp. Sta. Journal Series No. 2089. Approved by Director.

[2] Missouri Agr. Exp. Sta., Columbia.

THE RESPONSE OF SNAPBEANS AND WEEDS TO EPTAM UNDER DIFFERENT ENVIRONMENTAL CONDITIONS

Leo Rake and LeRoy Holm[1]

The response of snapbeans and weeds to EPTC (Eptam) applied at different times and in different ways was studied on a Plainfield sand in central Wisconsin. The influence of irrigation in varying amounts was also investigated. All of the work was done in the field using replicated experiments. Conventional portable irrigation with Rainbird sprinklers was employed. Incorporation, when used, was by means of a light harrowing, or in detailed studies, by a thorough raking. Such operations always placed the chemical in a moist medium. The predominant weeds were lambsquarters, rough pigweed, carpetweed, ragweed, purslane, and foxtails.

Eptam was applied to the soil at 3, 6, and 9 lb/A at the following times:

1. Seven days before planting (incorporated).
2. Four days before planting (incorporated).
3. Immediately before planting (incorporated).
4. Just after planting (a pre-emergence method).

One-half inch of rain fell early on the morning following planting. A similar amount came 3 days later.

The weight of the weed growth of *Chenopodium*, *Amaranthus*, *Ambrosia*, and the grasses was recorded for each species. Almost perfect weed control was in evidence one month later at all rates and treatments, except in the pre-emergence areas where less than 50% weed control was obtained. Forty feet of row per treatment was harvested in each replicate with a mechanical picker. No differences in yield were found with increasing rates of the herbicide in any treatment. Similarly, no significant differences in yield, attributable to method of treatment, were found at any Eptam rate. A comparison of the treated plots with the clean-weeded control plots is not available. The latter plots required cultivation and were inadvertently ridged. The harvester picked up small amounts of soil in the control plots and this was detected too late for correction of the error. It may be added that Eptam at 6 and 9 lb/A in this year showed quite severe leaf injury early in the season. Yields, however, were as high as those in the 3 lb/A treatment. In this area, in this and other years, 3 to 5 lb/A have not given reductions in bean yield.

The influence of rainfall (irrigation) on the response of crop and weeds was studied. Treatments were made as listed below:

1. Plant beans and irrigate immediately.
2. Plant beans, spray 5 lb/A Eptam on soil surface, and irrigate immediately.
3. Incorporate 5 lb/A Eptam, irrigate immediately, and plant beans immediately.
4. Incorporate 5 lb/A Eptam, irrigate immediately, and plant beans seven days later.

Appropriate areas in all of the above treatments received 1, 2, and 4 inches of irrigation. An additional

total of 1½" of rain fell during a 10 day period after planting. The results of this experiment may be summarized as follows:

1. All treated plots, including the pre-emergence treatment, showed excellent weed control. The untreated plots had heavy weed growth.
2. No differences in weed control could be detected under different levels of irrigation.
4. There was no significant effect on yield from method of treatment or irrigation level.
4. Cucumbers, which are extremely sensitive to Eptam, were seeded into all treated plots after planting the beans. The cucumbers did not survive in any area. Two months later soil samples were taken at intervals to 20 inches in all areas. No toxicity to cucumbers could be detected in any sample.

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PRE-EMERGENCE ON EIGHT VEGETABLE CROPS WITH SEVERAL HERBICIDES

R. Alden Miller[1]

Pre-emergence herbicides were applied on tomatoes, cabbage, onions, carrots, beets, peas, bush snap beans, and sweet corn. The herbicides and rates applied were EPTC granular 3 lb/A, and EPTC liquid 3 lb/A; 3-amino-2,5-dichlorobenzoic acid (Amoben) 6 lb/A; CIPC granular 4, 8, and 12 lb/A; dimethyl 2,3,5,6-tetrachloroterephthalate (DAC-893) 8 lb/A; DNBP 4 lb/A; dalapon 25% and silvex 6.25% (D/S) 1.55 lb/A; and granular CDAA at 4, 8, and 12 lb/A. EPTC was raked into the soil. The eight vegetables were planted with a V-belt and jab type planter on silty clay loam May 14, 1959 with the different vegetables in the same row to expedite treatments. The soil was moderately dry and the average air temperature was near normal. On May 19 and 23, 1.10 and 1.92 inches of rain fell respectively. Wettable powders and emulsions were applied with a three gallon knapsack sprayer using a three foot band, and the granular material was applied with a Gandy granular applicator using a twenty-eight inch band. Weed counts were taken June 8 on grasses (quackgrass and crabgrass combined), purslane and rough pigweed. Plots were hand cultivated, row weeding time recorded and crop injury notes taken. EPTC, both liquid and granular, gave moderate weed control with no injury to beets; slight injury to cabbage, corn and snap beans; moderate damage to tomatoes, carrots and peas; and severe injury on onions. Amoben gave complete weed control and severely injured or inhibited growth of all vegetables. Granular CIPC at 4 lb/A gave poor weed control with little injury to beets and snap beans; moderate damage to onions, carrots and corn; and severe distortion to tomatoes, cabbage and peas. Granular CIPC at 8 lb/A gave good weed control with no injury on onions and carrots; little injury to snap beans; moderate damage on beets and corn; with severe injury to tomatoes, cabbage and peas. CIPC at 12 lb/A gave excellent weed control with little injury on onions; moderate harm to carrots, snap beans and corn; and severe injury on tomatoes, cabbage, beets and peas. DAC-893 showed excellent weed control with no injury to onions, peas, snap beans and corn; minute injury to carrots; moderate distortion on cabbage and beets; and killed tomatoes. DNBP gave poor weed control with slight injury to tomatoes, beets, peas, snap beans and corn; and extreme damage to cabbage and onions. D/S gave poor weed control with no damage to corn; moderate harm to tomatoes, onions, beets, peas and snap beans; and severely injured cabbage and carrots. Granular CDAA at 4 lb/A gave good weed control with no injury to corn; slight damage on tomatoes and peas; moderate injury to cabbage, onions, beets and snap beans; and killed carrots. CDAA at 8 lb/A gave good weed control with no injury to corn; moderate damage to tomatoes, peas and snap beans; severely stunted cabbage, onions and beets; and killed carrots. CDAA at 12 lb/A also gave excellent weed control with no injury to corn; slight damage to peas and snap beans; severe stunting of tomatoes, cabbage and onions; and inhibited carrots and beets.

Promising results are listed in summary in the following table.

Crop	Choice of herbicides		
	1st	2nd	3rd
Tomatoes		CDAA 4 lb/A	EPTC 3 lb/A Spray
Cabbage	CDAA 4 lb/A	DAC-893 8 lb/A	
Onions	DAC-893 8 lb/A	CIPC 8 lb/A	CDAA 4 lb/A
Carrots	DAC-893 8 lb/A	CIPC 8 lb/A	
Beets		EPTC 3 lb/A Spray	
Peas	DAC-893 8 lb/A	DNBP 4 lb/A	CDAA 4 lb/A
Beans	DAC-893 8 lb/A	DNBP 4 lb/A	
	EPTC 3 lb/A	CDAA 4 lb/A	
Corn		CDAA 4 lb/A	DNBP 4 lb/A
		DAC-893 8 lb/A	D/S 1.55 lb/A

[1] Univ. of Illinois Drug and Horticulture Experiment Station, Box 58, Downers Grove, Illinois.

EFFECTS OF POST-TRANSPLANTING HERBICIDAL TREATMENTS ON TOMATOES[1]

J. W. Herron and D. J. Cotter[2]

In the 1958 screening tests the herbicides that appeared most promising for post-transplanting treatments on control of weeds in tomatoes were simazin, CDAA, CDEC, and neburon.

Table 1. Effects of herbicide treatments on yield and injury of tomatoes, 1958

Herbicide	Rate lb/A	Yield lb/plot	Injury ratings*
Simazin	1	11.6	0
Simazin	2	12.3	1
Neburon	4	8.6	2
CDAA	6	9.2	4
CDEC	4	9.0	2
CDEC	6	9.2	2
Check	—	10.0	0

* 0 = No injury. 9 = Very severe injury.

Herbicides that were also included in the 1958 tests but did not appear to warrant further testing were EPTC and Falone [tris(2,4-dichlorophenoxyethyl) phosphite].

The 1959 tests on tomatoes included simazin 1 and 2 lb/A; neburon 2 and 4 lb/A; CDAA 6 lb/A; CDEC 4 and 6 lb/A; diphenylacetonitrile (Lilly 13489); and (p-chlorophenyl)phenylacetonitrile (Lilly 09726).

All plants were set May 11, and the herbicides were applied May 14. Applications were made in a one-foot band over the plants. Crop injury ratings and weed counts on two different dates were taken. Results of the 1959 test are shown in Table 2.

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Table 2. Effects of herbicide treatments on yield, injury, and weeds in tomatoes, 1959

Herbicide	Rate lb/A	Yield lb/plot	Injury ratings*	Weeds per 2 sq ft
Simazin	1	10.2	4.0	4
Simazin	2	6.6	6.0	1
L 13489	4	10.4	1.0	9
L 13489	8	9.3	3.5	4
L 09726	4	11.8	1.5	10
L 09726	8	10.9	2.3	21
CDEC	4	8.1	3.5	10
CDEC	6	11.4	4.0	4
CDAA	4	14.1	3.0	4
CDAA	6	9.5	2.8	18
Neburon	2	9.8	2.5	4
Neburon	4	7.7	4.5	4
Check		9.4	1.5	24
	LSD .05	NS	3.5	10
	.01		4.9	14

* 0 = No injury. 9 = Very severe injury.

Of the herbicides used in 1959, simazin was the only one that caused significant top injury to the tomato plants. However, the injured plants apparently recovered; and although the yield was somewhat lower than the check, the difference was not significant. Most satisfactory weed control was obtained with simazin, L 13489, CDEC, and neburon. No significant difference in yields was obtained from any of the treatments.

Although additional information will be necessary before definite conclusions can be obtained, several herbicides appear promising as post-transplanting treatments for weed control in tomatoes.

[1] The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published with approval of the Director.

[2] Department of Horticulture, University of Kentucky, Lexington, Kentucky.

NEW CHEMICALS THAT SHOW PROMISE FOR WEED CONTROL IN CARROTS

G. F. Warren[1]

Experiments were conducted for two years on both muck and a silt loam soil in which several pre-emergence and post-emergence herbicides were applied. Weed counts were made approximately one month after planting in pre-emergence experiments and two weeks after spraying in post-emergence experiments. After counts were made, all plots were hand weeded and cultivated through the remainder of the season.

Of the pre-emergence materials Amoben (3-amino-2,5-dichlorobenzoic acid) and Dinoben (2,5-dichloro-3-nitrobenzoic acid) were outstanding in control of weeds. Weed control was excellent and lasted for several weeks, except when Dinoben was applied to dry muck soil and rainfall was insignificant for several days. This led to an experiment where a comparison was made between working these materials in before planting with a surface spray after planting. In this experiment weed control was poorer when the herbicides were worked in, apparently due to dilution with more soil. Carrots appeared generally tolerant to effective rates of application (2 to 4 lb/A) although there were two instances of injury at the 4 lb rate.

CIPC, the standard pre-emergence material used for comparison, gave fairly satisfactory weed control and no carrot injury at 8 lb/A in the silt loam soil. In muck soil, 16 lb/A failed to kill pigweed and certain other species and thus over-all weed control was poor. EPTC gave reasonably good weed control only when incorporated in the soil before planting and when this was done the carrots were killed or severely injured at effective rates.

In post-emergence experiments, Karsil [*N*-(3,4-dichlorophenyl)-2-methylpentanamide] was compared with Stoddard solvent. Karsil gave better control of galinsoga and lambsquarters than Stoddard solvent but poorer control of annual grasses. However, grasses were easily killed by Karsil if sprayed when very small (less than one inch tall). Carrots showed good tolerance to Karsil at rates of 2 to 4 lb/A at the one-true-leaf stage or later. The best time to apply this chemical appears to be as soon as most of the early weeds have emerged but while they are still small.

Two relatives of Karsil, Solan [*N*-(3-chloro-4-methylphenyl)-2-methylpentanamide], and Dicryl [*N*-(3,4-dichlorophenyl) methacrylamide] also gave good selective post-emergence control of weeds in carrots when used at slightly higher dosages.

[1] Purdue University, Lafayette, Indiana.

EVALUATION OF 2,6-DICHLOROBENZONITRILE AS A PRE-PLANTING SOIL-INCORPORATED AND A PRE-EMERGENCE HERBICIDE

E. S. Hagood[1]

(The experiments reported in this paper were conducted on the same plots as those reported on Page 36 on wild oats. The reader should see that article for the introduction to these tests. Ed.)

Peanuts, wheat, peas, snapbeans, soybeans, rice, oats, barley, sugar beets, and cabbage were planted one week and three weeks after treatment (May 29, 1959) in the first pre-planting soil-incorporated test. In the second test peanuts, wheat, and corn were planted on the day of the treatment (August 5, 1959).

The following crops were planted on June 12 and August 12 in the two pre-emergence tests—snapbeans, soybeans, peanuts, peas, potatoes, cotton, corn, barley, rice, wheat, sorghum, sugar beets and sunflowers. These tests were treated on June 16 and August 15, respectively.

Sugar beets, rice, wild oats, flax, sorghum, onions, corn, peas and peanuts were planted in the post-emergence test on June 25, 1959. The sprays were applied 23 days later.

The same rates of 2,6-dichlorobenzonitrile produced similar controls when applied in the two pre-planting tests. From 1 to 4 lb/A of 2,6-dichlorobenzonitrile in the second test controlled from 96.5 to 98.1% of the annual grasses (other than wild oats) and the broadleaved weeds.

Peanuts, peas, snapbeans, soybeans, wheat, oats, rice, and corn were planted one week and three weeks after treatment of the first pre-planting soil-incorporated test. None of these crops was tolerant of the 1 or the 4 lb/A rate of 2,6-dichlorobenzonitrile. At ¼ lb/A this compound did not injure the crops nor control the weeds. Peanuts and corn were partially tolerant of 1 lb/A. Peanuts, wheat and corn were not tolerant of either rate of 2,6-dichlorobenzonitrile in the second pre-planting test.

Counts, which were made in 30 to 32 days after treatment of the pre-emergence tests, indicated that 4 lb/A of 2,6-dichlorobenzonitrile was the only treatment which satisfactorily controlled annual grasses (including wild oats), and broadleaved weeds. In a later evaluation and vigor rating (10 to 12 weeks after treatment) the following practices resulted in a satisfactory commercial control: 3 or 4 pounds per acre of 2,6-dichloro-

benzonitrile; 3 pounds per acre of diuron; and 2 pounds per acre of simazin. The counts indicated that the 4 lb/A of 2,6-dichlorobenzonitrile was a safe pre-emergence herbicide in snapbeans, soybeans, peanuts, peas, potatoes, corn, barley, rice, wheat, and sunflowers. At the time of the counts the stands of cotton, sorghum, and sugar beets had been reduced by this treatment. At the time of the vigor ratings, only sugar beets and sorghum had been injured by the 4 lb/A of 2,6-dichlorobenzonitrile.

The intervals between planting, treating, and evaluation of the post-emergence test were 23 and 25 days, respectively. Four and six lb/A of 2,6-dichlorobenzonitrile did not injure peanuts, peas, rice and corn. Slight injury was observed on sorghums and onions. Flax exhibited moderate injury. 2,6-Dichlorobenzonitrile at 4 and 6 lb/A killed 37% and 60% respectively of the wild oats. The wild oats which escaped were injured slightly by 4 lb/A and moderately by 6 lb/A.

[1] Niagara Chemical Division, Food Machinery and Chemical Corporation, Research and Development Department.

DIMETHYL 2,3,5,6-TETRACHLOROTEREPHTHALATE (DAC-893), A PROMISING PRE-EMERGENCE TURF HERBICIDE

H. H. Harris[1], P. H. Schuldt[2], and L.E. Limpel[2]

Early evaluation work with dimethyl 2,3,5,6-tetrachloroterephthalate (DAC-893) at Boyce Thompson Institute showed this compound to have unusual pre-emergence herbicidal activity. It was particularly effective against crabgrass. Established turf and many crops exhibited a high degree of tolerance to DAC-893. Preliminary small plot field experimental work was carried out in 1958 at Yonkers, New York, and Painesville, Ohio. In 1959, besides these locations, DAC-893 was tested by many experiment station workers and other investigators on turf across the country.

Pure DAC-893 is a white crystalline compound with a low vapor pressure and is essentially odorless. It is less than 0.5 ppm soluble in water and sparingly soluble in acetone, cyclohexanone, xylene, and petroleum derived solvents. It appears to be stable in the pure state or when formulated as a wettable powder under usual storage conditions. Toxicological studies are not complete, but tests to date indicate the acute oral LD_{50} for male albino rats to be greater than 3000 mg/kg of body weight, with the acute dermal LD_{50} for albino rabbits greater than 10,000 mg/kg of body weight.

On May 2, 1958, a 50 percent wettable powder formulation of DAC-893 was sprayed on 25 sq ft plots at rates of 1.5, 3, 6, and 12 lb/A, replicated four times. Chlordane at 60 lb/A was also included in this test. There was ample rainfall to maintain good growth of turf grasses throughout the season. The results are summarized in Table 1.

Table 1. Relative effectiveness of DAC-893 and chlordane for crabgrass control in turf—1958.

Treatment	lb active/A	Percent crabgrass control July 11	Percent crabgrass control September 5
DAC-893 (W-50)	12	100	98
	6	99	87
	3	95	79
	1.5	75	32
Chlordane (W-50)	60	90	79
Check (% area covered)		29	52

DAC-893 in a wettable powder formulation was applied April 22, 1959 to 100 sq ft plots at rates of 7.5 and 10 lb/A, replicated four times. Dimethylamine salt of 2,4-D at 2 lb/A was applied and in combination with 7.5 lb/A of DAC-893. Chlordane at 10 lb/A, a level suitable for soil insect control, was also used in combination with 7.5 lb/A of DAC-893. On June 17 all treatments with DAC-893 were 100% effective. The mean area covered with crabgrass in the check plots was 16%, while in the plots treated with 2,4-D there was 34% crabgrass. This higher population may have been due to removal of broad-leaf weeds. Extremely dry weather in June and early July greatly reduced the crabgrass infestation, but with rainfall later an increased infestation developed. On September 4 the check plots contained 49 percent crabgrass on an area basis. The control with treatments of DAC-893 alone or in combination with either 2,4-D or chlordane was 97 to 99 percent. Neither 2,4-D nor chlordane adversely affected the performance of DAC-893.

On April 30, 1959, DAC-893 was applied to 3x3-foot plots, replicated three times, at three rates both as a wettable powder spray and as a granular formulation. Two different formulations of granules were applied at the five pound rate. Here again, dry weather affected the germination and growth of crabgrass. The results are summarized in Table 2, in which the percent control is based on the number of crabgrass plants per plot. At the five lb/A rate these granular formulations were not as effective as sprays.

Table 2. Relative effectiveness of different DAC-893 formulations at several rates and calcium arsenate for crabgrass control in turf—1959.

Treatment	lb active/A	Percent crabgrass control September 4
DAC-893		
1.25% granules (A)	5	82
1.25% granules (B)	5	87
1.25% granules (A)	10	99
1.25% granules (A)	12.5	100
50% w.p.	5	99
50% w.p.	10	97
50% w.p.	12.5	100
Calcium arsenate pelleted 73%	480 (formul.)	36
Check (crabgrass plants/plot)		31

The dry weather in 1959 precluded any evaluation as to possible adverse effect of DAC-893 on turf grasses. Work at Boyce Thompson Institute has shown that DAC-893 has little, if any, effect on established bluegrass turf even at levels in excess of those required for crabgrass control, but that some thinning of fescues may occur. No discoloration of turf has been noted.

DAC-893 has a herbicidal effect on germinating seeds of all turf grasses. Studies are under way to determine how long a period must elapse after treatment before reseeding can safely be done. Fall seeding of a predominantly fescue mixture was successful in 1958 following a spring application of DAC-893 at 12 lb/A.

The results reported to date from tests of cooperators across the country where DAC-893 was applied prior to crabgrass germination have generally been very satisfactory. It is felt that a 10 to 12 lb/A rate of DAC-893 would be optimum for use in crabgrass control in turf.

[1] Diamond Alkali Company, Research Center, Painesville, Ohio.
[2] Boyce Thompson Institute for Plant Research, Inc., Yonkers, New York.

THE RESPONSE OF OATS TO APPLICATIONS OF AMITROL

K. P. Buchholtz[1]

Amitrol has been useful in treating Canada thistle, quackgrass and several other weeds often found in field crops. Weeds growing in oats have seldom been treated with amitrol because severe injury to this crop seemed

likely. Attempts were made in 1958 and 1959 at Madison, Wisconsin, to determine more exactly the sensitivity of oats to amitrol. In 1958 weed-free plots of Beedee oats, 6 by 12 feet in size, were treated with amitrol at 1, 2, 4, and 8 lb/A. The amitrol was applied as a spray in water equivalent to 20 gal/A using a bicycle-mounted sprayer. Four replications were used in a randomized, complete block design. Applications were made when the oats were in the seedling stage, about 6 inches tall; in the tillered stage, when they were about 15 inches tall; and just after heading was completed. The oats were harvested at maturity and threshed.

In 1959 oats of the Beedee and Clintland 60 varieties were planted in adjacent blocks at the rate of 2 bu/A. Weed-free plots were treated with amitrol at rates of 1, 2, 4, and 8 lb/A as in 1958. Treatments were made when the oats were in the tillered stage and about 18 inches tall, and after heading was completed. At maturity the oats were harvested and yields obtained.

Table 1 shows the grain yields of Beedee oats obtained from plots treated with amitrol in the tillered stage in 1958 and 1959. Applications of 2 lb/A in 1958 and 4 lb/A in 1959 were required to reduce oat yields significantly. The yields at the 4 lb/A rate were 85% and 77% of check yields in 1958 and 1959. This indicates that oats have substantial tolerance to moderate applications of amitrol.

Table 1. Yields of Beedee oats after treatment with amitrol in the tillered stage.

Amitrol lb/A	Oat yield—lb/A	
	1958	1959
0	4290a	2840a
1	4000ab	2640ab
2	3450b	2580ab
4	3630b	2180b
8	2950c	2160b

The influence of date of treatment on tolerance of the oats is shown in Table 2. In 1958 Beedee oats appeared to recover more completely from applications made in the seedling stage than from those made in the tillered or headed stages. No substantial differences existed in the sensitivity of Beedee oats treated at the two later stages. However, Clintland 60 was injured more severaly by treatments made at the tillered stage than those made at the headed stage in the 1959 trial.

Table 2. Yield of oats after treatment with amitrol at 4 lb/A at several stages.

Stage when treated	Yield lb/A		
	Beedee		Clintland 60
	1958	1959	1959
Untreated	4290a	2940a	3020
Seedling	4000a	——	——
Tillered	3630b	2180b	1570
Headed	3510b	2040b	2150

A comparison of the yields from plots of Beedee and Clintland 60 is shown in Table 3. The data, expressed as percentage of check yields, indicate that the varieties differed materially in their response to amitrol at all of the rates used when treated in the tillered stage. The differences were much less pronounced when treatments were made at the headed stage.

Table 3. Yields of two varieties of oats after treatment with amitrol in 1959.

Amitrol lb/A	Yields as percent of check			
	Beedee		Clintland 60	
	Tillered	Headed	Tillered	Headed
1	93ab	90b	79b	83b
2	91ab	82bc	75b	86b
4	77b	72bc	52	71c
8	76b	66c	35	65c

Grain bushel weights and germination percentages, obtained from the trials with Beedee oats, are shown in Table 4. The bushel weights were not affected materially in either year. Germination percentages were high in all cases in 1958. In 1959 the germination percentages were more variable, probably due in part to unfavorable weather prior to threshing. However, no significant differences in germination were found in 1959.

Table 4. Bushel weights and germination percentages of Beedee oats after treatment with amitrol.

Amitrol lb/A	Bushel wt—lb/bu		Germination—pct	
	1958	1959	1958	1959
0	38.3a	30.9a	99a	86a
1	39.3a	32.0a	99a	88a
2	38.9a	30.8a	100a	80a
4	39.1a	31.0a	99a	82a
8	38.1a	29.0b	100a	79a

The data indicate that oats will tolerate herbicidal applications of amitrol and suffer only moderate reductions in yield. Oats of the Beedee variety appeared to be more tolerant of amitrol than those of the Clintland 60 variety. The most promising time to treat weeds is probably during the tillered stage because at this time the weeds have a good leaf growth and would not have exerted their full damage through competitive effects. Bushel weights and germination percentages of grain were not affected adversely by applications of 4 lb/A made at this time. An amitrol application of 4 lb/A would give a marked response on Canada thistles and other susceptible weeds, with only a moderate reduction in the yield of grain.

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INTRODUCTORY STUDIES OF AN EFFECTIVE WILD OAT CONTROL CHEMICAL

J. M. Deming, C. L. Wilson, P. C. Hamm, and J. J. D'Amico[1]

The magnitude of the wild oat control problem throughout the world and particularly in Western Canada has accelerated the search for an effective and specific wild oat control chemical. Monsanto has participated actively in this search and we now believe we have found a highly effective and a highly specific wild oat killer.

Chemically this wild oat killer is a *cis* and *trans* isomeric mixture of 2,3-dichloroallyl diisopropylthiolcarbamate. It has been field tested under the code number CP 15336, and the trademark "Avadex"[2] has been registered. Physically it is a yellow oil with a boiling point of 118-119°C. at 1 mm. Hg. It is relatively insoluble in water but readily soluble in most organic solvents. It can be easily formulated as an emulsifiable concentrate.

For pre-emergence evaluation, Avadex was applied in spray form to pans of soil seeded ⅜" deep to representative grass and broadleaf plants. Observations on the germination inhibition were made on the 14th day after planting. To simulate a soil incorporation preplanting treatment, the test chemical was sprayed on, and thoroughly mixed with, the ⅜" cover layer of soil. After covering the seed with the treated soil, the pans were germinated and read as for the pre-emergence evaluation.

The herbicidal ratings for each plant species were made according to this scale: 0 to 25% germination and emergence = 3; 26 to 50% = 2; 51 to 75% = 1; and 76-100% = 0. The test plant species and the results obtained in the greenhouse on this group of plants are given in Table 1.

Table 1. Herbicidal rating of Avadex applied pre-emergence on several plant species.

Plant species	Surface application rate, lb/A 25	1	½	⅛	Soil incorporation rate, lb/A ⅛	1/16
Wild oats	3	3	3	0	3	3
Bromegrass	3	3	3	0	3	3
Ryegrass	3	3	3	0	3	2
Crabgrass	3	3	0	0	1	0
Giant foxtail	3	3	3	0	2	2
Sorghum	3	3	2	0	3	3
Annual morningglory	3	0	0	0	0	0
Pigweed	3	1	0	0	1	0
Wild buckwheat	..	1	1	0	0	0
Sugar beets	2	3	3	0	0	0
Radish	1	1	0	0	0	0
Tomato	..	0	0	0	0	0
Soybean	..	0	0	0	0	0

Incorporation into the top soil improves the performance of this chemical 4 to 8 fold. At rates of 4 lb/A and above this compound effectively controls wild oats and some other weedy grasses when applied as a foliage spray to seedlings up to two weeks old.

Additional greenhouse studies in several soil types have shown that cheat, wild oats, foxtail, crabgrass and barnyard grass can be removed at rates of one pound per acre or less. Corn appeared very resistant in greenhouse tests but formative injury showed up in field tests at rates above four pounds per acre. Domestic oats and sorghum appear almost as susceptible to injury as wild oats.

Avadex is a grass specific herbicide and is not outstandingly active against broadleaf crops and weeds. Greenhouse tests show some activity against pigweed, plantain, and ragweed. Field tests bear out the fact that pigweed is fairly susceptible.

In the greenhouse, muskmelon, tomato, sugar beets, alfalfa, peas and turnips showed considerable resistance. Cotton and soybeans were highly resistant. In field tests at St. Louis this year, cotton, soybeans, muskmelon, tomato, sugar beet, alfalfa, and snap beans were all highly resistant.

Avadex is the most consistent pre-emergence herbicide ever tested by these authors under greenhouse conditions and also the most active on wild oats. One ounce per acre consistently prevents wild oat germination and emergence in soil incorporated pre-emergence tests in the greenhouse. This presents an encouraging picture for an answer to the wild oat problem.

[1] Monsanto Chemical Company, Organic Chemicals Division, Research Department, St. Louis, Mo. and Nitro, W. Va.

[2] Trade Mark of the Monsanto Chemical Company, St. Louis, Missouri.

AVADEX[1], A SELECTIVE WILD OAT HERBICIDE

L. H. Hannah[2] [3]

The wild oat (*Avena fatua*) ranks as the number one weed problem which has plagued the farmer on the Prairie Provinces of Canada for many years. For nearly ten years, Monsanto Chemical Company has been synthesizing and screening thousands of chemicals, searching for compounds to control wild oats. Results from this work indicated that CP 15336 (2,3-dichloroallyl diisopropylthiolcarbamate) consistently controlled wild oats in flax, barley and wheat. Monsanto has since established for CP 15336, as a wild oat herbicide, the trademark "Avadex."

It was decided to subject Avadex to commercial farm conditions. With the assistance of the research workers, 6 cooperators in Manitoba, 5 in Saskatchewan and 5 in Alberta were nominated for an on-the-farm demonstration program, which involved 190 acres of tests. At each location, rates of 1, 1.2, 2, 2.5, and 3 pounds were used. At 15 locations one-half of the experimental area was given a single incorporation and the other half a double incorporation to a depth of 2 to 3 inches the same day the chemical was applied. At one location Avadex was applied *following* the seeding of flax, and a harrowing constituted the incorporation. With that exception, flax, barley, wheat and sugar beets were seeded in the treated fields from 1 to 33 days following application. The conditions included: (1) Soil types from sandy loam to heavy clay loam; (2) Applications on soils ranging from those having a dry mulch to those that were "too wet" for good incorporation; (3) Soil temperatures at a 3" depth at time of application from 38° to 68° F.; (4) Rainfall from 2.5" to 17" during the major portion of the growing season. At two locations, 4" of snow fell the night after application; (5) Applications on both stubble and summer fallow ground; (6) Wild oats were found to be germinating at a depth of 5-6"; (7) Part of the farm tests were disced for the second time from 7 to 33 days after application.

Based on the results of several years' field testing, the 1959 commercial farm program, and observations of trials at experiment stations in Canada and the United States, the following conclusions regarding Avadex may be made:

1. Avadex at the rate of 1.5 pounds per acre gave consistent and excellent wild oat control (in the range of 90 to 99%) under actual farm conditions. The chemical should be considered primarily as a wild oat herbicide. The average farmer should be able to use Avadex successfully.

2. In the farm program, flax, barley and sugar beets demonstrated adequate tolerances to rates required for satisfactory wild oat control.

3. Yield data which were available from a majority of farmer tests showed a substantial increase from the use of Avadex. The heavier the infestation of wild oats, the greater the increase in yield.

4. In work conducted by the experiment stations, other crops such as sunflower, peas, rape and possibly wheat appear to be tolerant to Avadex.

5. In experiment station tests in Canada, when the chemical was applied with a logarithmic sprayer, approximately 95% control was obtained at rates ranging from 1.2 to 1.5 pounds per acre.

6. Wild oat control is increased only slightly when rates higher than 1.5 pounds per acre are used, provided proper incorporation procedures are followed at the lower rate. Only when applied on stubble ground was it found necessary to increase the rate of 2 pounds.

7. When "Avadex" is applied on summer fallow ground, a single incorporation is sufficient. If stubble ground is being treated, two incorporations of the chemical in the top 2 to 3 inches of soil are required.

8. The soil should be in good working condition at the time of applying the chemical to insure proper mixing.

9. Soil type and temperature at time of application and rainfall following the treatment appear to have little or no influence on the effectiveness of Avadex.

10. Avadex has a rather long soil life, which will enable it to control wild oats through a germination period of 6 to 8 weeks.

11. Reworking areas for periods up to 33 days after treatment did not destroy the effectiveness of "Avadex."

[1] "Avadex," trademark of the Monsanto Chemical Company.

[2] Monsanto Chemical Co., St. Louis, Missouri.

[3] Many people have contributed to the results reported in this paper, but especial acknowledgement is due to Mr. Robert A. Conkin, who devised and carried out the meticulous analyses for residues in the crops and Dr. Ernest G. Jaworski, who conducted the radioactive tracer studies, both of whom are in our Agricultural Research Laboratory.

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RESULTS OF FIELD TRIALS WITH CARBYNE [4-CHLORO-2-BUTYNYL N-(3-CHLORO-PHENYL) CARBAMATE] ON THE CONTROL OF WILD OATS IN WHEAT, BARLEY AND FLAX

P. W. Gull, H. C. Zeisig, Jr., Jean R. Epperly, J. W. Pullen, Kenneth P. Dubrovin, J. W. Jones, and J. A. Eck[1]

Several factorial experiments were run in the United States and Canada wherein rates, time of application, spray volume and formulation were compared. Other experiments were designed to study reactions of varieties of wheat, flax and barley, to Carbyne at different rates and times of application. The compatability of Carbyne with MCP amine was studied. Nozzle types were also investigated.

It was found that spray volume was not an effective factor when different volumes were obtained by holding all other factors constant except speed. No difference in activity was apparent between the several emulsifiable concentrates.

Rates per acre and time of application proved to be the only factors significantly affecting the activity of Carbyne.

One-half pound per acre was superior to ¼ lb/A but not quite so effective as 1 lb/A for the control of wild oats. Yields were not significantly different for wheat and barley between ½ and 1 lb/A. Both rates were superior to check and ¼ lb/A. Stunting was slight on Selkirk wheat with 1 lb/A but not evident with ½ lb/A. Flax was rather severely stunted with 1 lb/A and slightly with ½ lb/A. However, with heavy wild oats competition both rates gave significant yield increases.

Application timing proved to be a highly effective factor in controlling the activity of Carbyne in controlling wild oats. The most effective morphological stage of wild oat development was between the 1¼ to 2¼ leaf stage or 4 to 9 days after emergence when the plants were developing normally. Application dates earlier or later than this range gave increasingly less control with time.

There appeared to be no interaction between MCP amine and Carbyne in the control of wild oats and broadleaf weeds nor injury to the crops.

Spray nozzle type did affect the activity of Carbyne. Hollow-cone nozzles were about twice as effective as the fan-type nozzle and solid-cone nozzles were intermediate.

Yield increases of 5 to 6 bushels of wheat, 6 to 15 bushels of barley and 2 to 6 bushels of flax were obtained where medium to heavy infestations of wild oats were present.

[1] Spencer Chemical Company, Kansas City, Missouri

EXPERIMENTAL EVALUATION OF HERBICIDES FOR WEED CONTROL IN COMMERCIAL CORN AND SORGHUM PRODUCTION

Glenn D. Moore[1]

Chemical weed control can be cheaper and more efficient in seed production of corn and sorghum than any other method of weed control for the commercial company. However, the commercial company is faced with problems that the farmer and many researchers seldom encounter. Much of the weed control problem faced by the commercial producer is in his research and breeding grounds, his parent line increase fields, and his crossing fields, where he takes the first steps toward producing the hybrid seed he will later market.

Genetically, parent lines in many crops are as variable in their reactions to chemicals as they are variable in the time required for them to reach maturity or in many other characteristics. Therefore, the producer must try to test his material rather thoroughly before it is subjected to herbicide treatment. The reasons are twofold. First, the variable reaction of selfed lines could cause some loss of stand, some stunting, some delay in development which might well prevent proper pollination, or even complete loss of irreplaceable breeding material. Secondly, while it is quite well established that environmental and climatological factors greatly influence many herbicide-plant reactions especially in inbred parent lines, some of the same or unknown sets of conditions may well cause adverse effects in the resultant hybrids as well, even though hybrids are generally less susceptible to such reactions. Hybrids containing susceptible inbred or parent lines should at least be considered to be predisposed to herbicide reaction.

The research trials conducted by Northrup King are primarily replicated trials on inbred lines, with a few observations on single crosses. Plots are one rod wide strips applied broadcast across the 100 to 150 entries included. They are usually conducted in a farm field under average weather and soil conditions for the area, and over the years have been on a wide range of soils from sandy loams to heavy red clay.

Results have been as follows:

1953—Heavy clay loam, ample rainfall including 1.55 inches during the first nine days after spraying. DNBP 6 lb/A pre-emergence caused serious stand loss. Monuron 1.75 lb/A and DNBP amine (Dow Premerge) 3 lb/A early post-emergence caused temporary leaf burn. Weed control was good. Sesone 2.5 lb/A pre-emergence resulted in excellent weed control.

1954—Sesone 2.5 lb/A used extensively with excellent weed control from both pre-emergence and lay-by applications. Five sweet corn inbred lines were affected. Severe "onion-top" on from 3 to 5% of plants resulted. Again moisture was more than adequate.

1955—Dry—no pre-emergence herbicide was satisfactory. Premerge applied from coleoptile stage to four leaf stage delayed pollination and maturity of a few field corn lines by three to ten days, and completely destroyed some sweet corn lines.

1956—Extremely dry. Diuron 1.5 lb/A was severe on corn; NPA (Alanap) 3 lb/A affected 7.9% of lines included: sesone 4 lb/A and diuron 0.75 lb/A both affected 7.1% of the corn lines; Premerge 4 lb/A, and Premerge 3 lb/A plus sesone 2 lb/A, both applied early post-emergence, affected 3.1%; CDAA (Randox) 4 lb/A and 2,4-D propylene glycol butyl ether (PGBE) ester 1 lb/A caused slight stunting on some lines; Randox 4 lb/A and Premerge 3 lb/A early post-emergence caused little damage and gave excellent weed control.

1957—Moisture fairly good at planting time. Simazine 2 lb/A as a spray affected 5.2% of the corn lines by stunting and thinning of stands, but in granular form caused no ill effects; Randox 4 lb/A, 95 to 98% weed control with slight stunting on 4.5% of lines sprayed pre-emergence, and 80 to 90% weed control but affecting 2.2% of the corn lines slightly when applied in four-leaf stage. EPTC 5 lb/A was erratic and affected 3% of the corn. Premerge 3 lb/A early post-emergence stunted or delayed 38.1% of the corn lines. Simazine 2 lb/A pre-emergence gave all-season control and no damage on hybrid sorghum. Randox 4 lb/A stunted plants in four varieties or hybrids. Premerge 3 lb/A as a post-emergence spray significantly reduced stands. Simazine 2 lb/A in granular form, 2,4-D PGBE ester 0.25 lb/A, and 2,4-DB 1 lb/A were ineffective.

1958—Extremely dry. No sorghum emerged in plots. CDAA plus trichlorobenzyl chloride (Randox T) 4 lb/A, was best for weed control with Randox 4 lb/A next. Neither controlled all ragweed, lambsquarters or wild

morningglory. Simazine 2 lb/A and tris(2,4-dichlorophenoxyethyl) phosphite (3Y9) 4 lb/A were generally ineffective except that 3Y9 was most effective on wild morningglory. EPTC 5 lb/A quite severely damaged 34% of corn included.

1959—Fair moisture supply—good moisture two weeks after treating. EPTC pre-plant incorporated, 1.3 and 2.5 lb/A, caused some crop loss and poor weed control. Granular or spray forms of most materials were equally effective. 2,3,6-TBA 2 lb/A was most effective but severe on corn and destroyed sorghum. Atrazine and simazine at 1.5 to 2.0 lb/A were 40 to 60% ineffective. Randox 3 to 3.5 lb/A was effective except on ragweed, smartweed and wild morningglory. Randox in combination with 2,3,6-TBA at ½ rates was still too severe on corn, but gave excellent weed control. Diuron 1.5 lb/A was most effective on sorghum but redroot pigweed soon filled in as it did in 1953.

In summary, weed control should in part be conducted on parent lines of crops to detect range of susceptibility and safe rates. A weed control material would be ideal if it were: a) effective from planting time through early post-emergence to be usable when the weather and soil would permit application; b) be effective against all annual weeds with sufficient residual to take out late appearing weeds such as velvetleaf; c) and be economical enough to be applied broadcast so as to prevent the formation of weed sods between the rows.

[1] Research-Service Dept., Northrup, King & Co., Minneapolis, Minn.

CHEMICAL WEED CONTROL IN CORN

L. E. Anderson[1]

The use of herbicides to control weeds has been a step forward in efficiency and economy in corn production. Newer and more effective chemicals may eventually replace the combinations of cultivation and herbicidal applications now employed. Rapidity of this transition undoubtedly will be determined by effectiveness of the herbicides.

Fluctuations in annual and seasonal rainfall, humidity and temperature are known to cause variations in results where herbicides have been used as pre-emergence or post-emergence treatments for control of annual weeds in corn. As a consequence certain conditions may determine the success or failure of a given herbicide for a given year. During three years of observations under Kansas conditions it has been found that soil moisture during the times of application and immediately following has greatly influenced the final results. When compared with the highly successful results obtained with triazine compounds in 1957 and again in 1959, we attribute the failure in 1958 to exceedingly dry conditions when the herbicides were applied together with the hot, dry period that followed.

In the experiment reported for 1959 the hybrid K-28-22 was planted May 2, pre-emergence applications were made May 8, and the corn emerged May 12. Post-emergence applications were made May 29 when corn plants were in the 4-5 leaf stage and numerous annual weeds had emerged. The experimental design included two-row plots 42 feet long in randomized blocks with three replications. No cultivation was used in any of the plots where chemicals were applied. Seven inches of rainfall in May was followed by drought conditions in June.

Table 1. Herbicide rates, yield per acre for three replications, and counts of weeds in a 6-foot quadrat at harvest, broadleaved weeds first, then grasses.

Herbicide	Rates (lb/A)	Yield (bu/A)	Weed count (broadleaved-grasses)
Simazine	2, 3, 4	84, 78, 85	2- 6, 0- 5, 0- 3
Atrazine	2, 3, 4	70, 80, 81	0-19, 0-14, 0- 8
(2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine)			
Atrazine (post)	2, 3	66, 66, —	0-31, 0-36 —
Falone	2, 4, 6	67, 74, 75	2-31, 1-20, 2-29
(tris(2,4-dichlorophenoxyethyl) phosphite)			
DNBP	2, 4, 6	65, 70, 67	13-33, 9-25, 14-32
(Premerge)			
CDAA	3.5, 5	70, 61, —	7-26, 3-22,
(Randox)			
Amitrol (post)	3, 6	61, 38, —	0-20, 0-23,
Cultivation		76	0- 0
No cultivation		53	10-33

Although Randox and Falone did not control weeds throughout the year, both herbicides gave highly satisfactory control until late summer. Atrazine applied post-emergence did not control annual grasses. Simazine not only controlled weeds throughout the entire growing season but corn yields were significantly higher than yields from plots given ordinary cultivation. This was not true in 1958 when simazine treated plots yielded significantly less.

In a supplementary experiment grain sorghum was severely injured by triazine compounds in 1958. In a similar experiment conducted in 1959, simazine or Atrazine did not significantly reduce yields, and no injury to the treated plots was observed. Weed control was excellent in 1958 but only satisfactory in 1959.

[1] Kansas State University, Manhattan.

COMPARISON OF SIMAZINE AND ATRAZINE FOR WEED CONTROL IN CORN

E. O. Schneider[1]

Among the many new herbicides which have been developed within the past few years, a group of materials based on the triazine ring have shown considerable promise. For weed control in corn, two of these triazine herbicides, namely Simazine (2-chloro-4,6-bis(ethylamino)-*s*-triazine) and Atrazine (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine) have been placed on the market, primarily as pre-emergence herbicides. The purpose of this discussion is to outline the similarities as well as the differences between Simazine and Atrazine.

Under normal circumstances there is little to choose between these two compounds. However, Simazine and Atrazine can be compared for weed control on corn using the following criteria:

1. **Corn tolerance.** Corn is extremely tolerant to both Simazine and Atrazine. Dosage rates many times that required to adequately control weeds caused no noticeable adverse effects on corn. Residue analyses of various parts of the corn plant indicated the absence of both materials. Subsequent radioactive studies proved that although both Simazine and Atrazine are taken up by the root system of the corn plant, the plant rapidly metabolizes both materials. It was established that corn is so tolerant to both Simazine and Atrazine that even under adverse weather and growing conditions, and with gross overdosages of the chemicals, herbicidal injury was practically non-existent. On the basis of these findings, Simazine and Atrazine have been registered with the U. S. Department of Agriculture as pre-emergence herbicides on corn on a no-residue basis.

2. **Post-emergence application:** Simazine has little if any foliage contact value. This is in contrast to Atrazine, which is effective when applied post-emergence against broadleaf weeds and grasses, being more effec-

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tive against the former than the latter. Atrazine performs most favorably if applied at about 2 lb/A active on an overall broadcast basis to weeds and grasses which are not more than 1½ to 2 in. high at the time of application. This advantage is of importance if herbicidal treatment cannot be made at planting time.

As a pre-requisite to obtaining registration for post-emergence use of Atrazine in corn, corn plants treated post-emergence with the chemical have been analyzed for possible residue. Residue analyses indicate practically zero residue about one month after application, even when applied at a rate as high as 8 lb/A active. Registration is pending for Atrazine as a post-emergence herbicide on corn to be applied when weeds are no more than 2 inches high.

3. **Weed control:** Simazine and Atrazine effectively control a wide variety of annual grasses and broadleaf weeds such as barnyardgrass, chickweed, cocklebur, foxtail, lambsquarters, pigweed, purslane and ragweed, to name a few. As might be expected, Simazine and Atrazine show a varying degree of selectivity on certain weeds to the extent of making a choice of one of the two advisable.

Velvet leaf has been observed to be more sensitive to Atrazine than Simazine. Atrazine, because of the higher water solubility, is able to move into the deeper germinating zone of velvet leaf. More sensitivity and ease of placement of Atrazine in the seed germinating zone make Atrazine the preferred chemical for areas known to be infested with velvet leaf.

In areas heavily infested with barnyardgrass, several species *Panicum*, and crabgrass, Simazine at recommended rates will give longer control than Atrazine. Although controlled early in the season by Atrazine, these species will sometimes reappear before fall. These species have been observed to tolerate higher rates of Atrazine than Simazine. With more tolerance to Atrazine and a shallow root system, these species probably re-establish in the leached surface zone.

4. **Solubility factor:** These triazines differ in their solubility, Simazine solubility being about 5 ppm while Atrazine is about 70 ppm at a temperature of 20-25°C. Under adequate rainfall conditions, this marked difference in solubility is not a serious factor in weed control. If an unusually dry season occurs, or if corn is being grown in an area of low rainfall, then the added solubility of Atrazine becomes an important consideration in the choice of chemical to use.

Atrazine appears to act on weeds a little faster than Simazine, due in part, at least, to this factor of greater solubility. However, the lower solubility of Simazine has the advantage of affording a longer period of weed control.

[1] Geigy Agricultural Chemicals.

POST-EMERGENCE APPLICATIONS OF NPA (ALANAP®) AND FALONE (TRIS(2,4-DICHLOROPHENOXYETHYL) PHOSPHITE) GRANULES ON SOYBEANS

B. S. Morgan[1]

Soybeans (var. Harasoy) were planted May 14 in a field heavily infested with giant foxtail. Post-emergence granule applications were made with a Gandy herbicide applicator on June 2 in a 14-inch band centered over the row. Rates of 2, 4, and 8 lb/A were used with both herbicides. Granules were formulated as 10 per cent active on a 15/30 attaclay carrier. Soybeans were approximately 3-4 in. high and giant foxtail seedlings about 1-2 in. at time of treatment.

Four weeks after application the giant foxtail showed very distinct blade browning and malformation of the growing tip in all plots treated wth Alanap granules. This effect persisted and resulted in practical control by mid-season. Falone treated plots resulted in similar control at the 4 and 8 lb/A rates. There was no evidence of chemical injury to the soybeans at the rates tested.

[1] Agricultural Chemical Division of the United States Rubber Company.

GRANULAR HERBICIDE FORMULATIONS FOR WEED CONTROL IN CORN[1]

W. G. Lovely and D. W. Staniforth[2]

One of the new developments in controlling weeds in corn is the use of granular herbicide formulations. In Iowa we have been investigating the possibility of using granular herbicides for weed control in corn since 1954. Many of you heard the progress report on the use of these materials at the NCWCC in Cincinnati last year. Today we will be mainly concerned with our 1959 results. We will, however, relate the 1959 findings to results from previous years.

Are granular formulations as effective as sprays? The 1959 results like those from previous years show that pre-emergence applications of granular formulation of 2,4-D, CDAA, EPTC (Eptam), and simazine were about as effective as sprays. With 2,4-D slightly better control was obtained at rates below 2 lb/A with the liquid formulations than with the granules. Granules applied when the corn was at the 1 to 3 leaf stage in conjunction with shallow cultivations were equal to or better than sprays.

Working granules into the soil at the time of application appears to add little to their effectiveness. In 1959 rotary hoeing or harrowing granular formulations of 2,4-D CDAA, or Simazine into the soil did not improve the weed control obtained. In years when the soil surface was dry following application, working granules in improved the weed control obtained. The effectiveness of highly volatile herbicides such as Eptam is improved by working them into the soil.

How many granules are needed per unit area to obtain satisfactory control? The answer to this question depends on the herbicide used and the kind and size of carrier as well as how the chemical is released from the granule. Attapulgite clay at the 24/48 mesh size was impregnated with 5, 10, 20, and 25 percent 2,4-D ester; with 6.25, 10, 12.5, and 25 percent CDAA; and with 4 and 8 percent simazine. These formulations were applied as pre-emergence treatments on corn and results indicate very little difference in effectiveness. In terms of number of granules per unit area or coverage required, these results show that for 2,4-D at the 2 lb/A rate, 10 granules per square inch were as effective as 50 per square inch. For CDAA 20 per square inch were as effective as 80. These results are similar to those obtained in previous years using various percentage formulations of CDAA. The 8 percent Simazine formulation was not as effective as the 4 percent and the 95 granules per square inch gave better control than 47.

Granule size also influences the coverage obtained. Using 2,4-D low volatile ester as a chemical and attapulgite as a carrier, mesh sizes of 24/48, 20/40, and 15/30 were compared as pre-emergence applications. The 10 percent formulations were applied at the 2 and 4 lb/A rates. The number of granules per square inch varied from 4 to 25 for 2 lb/A and 8 to 50 for 4 lb/A. Neither the weed control nor the crop yields were materially different for any of the treatments. This indicates that size of granule *(within the range tested)* has little or no influence on weed control obtained.

There are many carriers that could be used for granular herbicides. In fact, it may be possible to granulate the chemical itself. Field trials were made using ben-

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tonite, attapulgite and pike's peak clay as carriers. With 2,4-D ester as the toxicant, pre-emergence applications were made on field corn using 2 and 4 lb/A. Results indicated no difference in weed control or crop yields due to kind of carrier used.

Because granular characteristics (size, carriers, and percent formulations) show very little influence on the effectiveness of granular herbicides, it appears that the metering equipment available for granular insecticides will be adequate for granular herbicides. Uniform distribution over the area treated is more important with herbicides but this is not highly critical as indicated by the control obtained with 5 to 50 granules per square inch.

Granular formulations make it easy and convenient for farmers to apply pre-emergence herbicides. Sprayer and water supply problems are eliminated with the seed, fertilizer, and pesticides in sacks only one supply wagon is needed. In addition chemical companies and not farmers are doing the mixing. The obvious disadvantages of more storage, more handling, and new equipment has not slowed down the interest in granular herbicides.

On 1,200 acres of corn at Iowa State University in 1959 planter attachments were used to apply 2,4-D ester granules in 14-inch bands. Excellent weed control was obtained using 2 lb/A with a 20 percent formulation on attapulgite clay. On 600 acres the corn was cultivated twice and on 500 acres only one cultivation was needed. Damage occurred on approximately 25 acres where about 4 lb/A was applied and heavy rainfall occurred soon after planting.

Commerical equipment was used for these applications, and although some machine improvements were indicated granules were adequately distributed for good control. The equipment companies have indicated that the needed changes have been made. Granular herbicide formulations make application easier and convenient.

[1] Joint contribution from the Iowa Agr. Exp. Sta., Ames, and Agricultural Engineering and Crops Research Divisions, ARS, USDA.

[2] Agricultural Engineer, Agricultural Engineering Research Division, ARS, USDA, and Associate Professor of Botany and Plant Pathology and Farm Crops, respectively.

COMPARISON OF GRANULAR AND LIQUID FORMULATIONS OF 2,4-D UNDER VARIOUS SIMULATED RAINFALL CONDITIONS

David W. Staniforth and Walter G. Lovely

The emulsifiable concentrate and various clay granule formulations of the iso-octyl ester of 2,4-D were compared in a number of laboratory tests. These tests were designed to measure movement of 2,4-D in soil under simulated rainfall conditions, and to evaluate the importance of size and kind of clay granule with respect to the availability of 2,4-D under these simulated conditions. The granular carriers studied were bentonite, attaclay and attapulgite. Bioassay techniques were used to estimate the amounts of 2,4-D present in various granule size fractions, soil, and leachate samples. Corn seeds were germinated in samples to be assayed and the weights of germinated seedlings obtained and compared with the degree of seedling inhibition produced with known concentrations of 2,4-D. Radish and turnip seedlings were used in some tests to check for smaller amounts of 2,4-D. Rainfall was simulated by placing cellulose sponges on top of soil in cardboard cylinders and slowly dripping the desired amounts of water onto the sponges. This resulted in uniform and steady infiltration of the soil. This technique was used to study the vertical movement of both liquid and granular formulations of 2,4-D iso-octyl ester in the soil.

With the materials studied and conditions encountered in these experiments, the following conclusions were drawn:

1. In general there was little difference in the amount of 2,4-D iso-octyl ester present on the various sizes of granules within a range of 30 to 100 mesh found in a commercial granular 2,4-D formulation.

2. When 2,4-D impregnated granules were left to soak in water for various lengths of time and then filtered, bioassay of the filtrates gave estimates of the amounts of 2,4-D removed by the soaking. Approximately seventy-five percent of the iso-octyl ester of 2,4-D was removed from attapulgite and bentonite granules after 12 hours of soaking in water. About 25 percent was removed in 3 hours and essentially all of the 2,4-D parent acid lost 90 percent of the 2,4-D with three hours of soaking in water.

3. Ester impregnated granules were concentrated in the middle of petri plates filled with soil and planted with turnip seeds, and the circular patterns of seedling inhibition around the pockets of granules were used to evaluate the extent of lateral movement of the 2,4-D in the soil. Of the clay granules tested, bentonite gave the slowest release of 2,4-D, but the difference was not large enough to be of any importance under field conditions. Equal amounts of 2,4-D ester released in the centre of the petri plates produced complete inhibition of all turnip seedlings in the dish.

4. Results from a total of three separate tests showed that there was very little difference in the amount of liquid and granular formulated 2,4-D ester which was leached from the surface of the soil or the depth to which it was leached, following simulated rainfall of 2 inches over a 12-hour period. With a given type of granule, percentage of toxicant per unit weight was of no importance in this respect. In general the 2,4-D acid impregnated granules resulted in deeper movement of the 2,4-D into the soil profile than was obtained with either liquid or granular formulated ester.

5. In general it may be concluded that the granular formulations of 2,4-D iso-octyl esters were very little different than the liquid formulations under the conditions of these tests. From this we conclude that the differences between these two formulations would be similarly slight when used as residual pre-emergence herbicides under field conditions.

"RANDOX[1] T", A NEW BROAD SPECTRUM PRE-EMERGENCE HERBICIDE

Lowell S. Gleason[2] [3]

When CDAA, designated Randox[1], was first introduced to the research workers at the North Central Weed Control Conference in 1954, it was pointed out that the active ingredient, (α-chloro-*N*,*N*-diallylacetamide) was especially effective against grassy weeds. Subsequent commercial use has continued to show CDAA to be outstandingly effective against grasses but that at the recommended rates many broadleaf weeds were not controlled. Combinations with 2,4-D were tested both by experiment station workers and commercial growers, but corn suffered typical 2,4-D injury symptoms. Meanwhile, at Monsanto's Agricultural Research Laboratories, a synthesis and testing program to find a safer additive for CDAA led to the discovery of both trichlorobenzyl chloride and trichlorotoluene as pre-emergence, broadleaf herbicides which could be used safely on corn. A field testing program was car-

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ried on for several years which has now resulted in commercialization of a new broad spectrum herbicide for weed control in corn. This new herbicide has been given the trade-mark Randox[1] T.

Randox T is a combination of CDAA and trichlorobenzyl chloride (TCBC). This combination has given broad spectrum control of both broadleaf weeds and grasses. With the addition of TCBC, weed control has been enhanced for the weeds usually controlled by Randox; the foxtails, crabgrass, annual bluegrass and sandbur; and, in addition, control has been achieved of ragweed, annual morningglory, smartweed, butterprint, pigweed, purslane, Russian thistle, lambsquarters, mustard, and groundsel.

A combination of 4 pounds of CDAA and 5.5 pounds of TCBC was tested at 10 experiment stations in 1957 with excellent control of both annual grasses and broadleaf weeds. This formulation was extensively tested in 1958 by both experiment stations and commercial organizations, at 3 pounds of CDAA and 4.10 pounds of TCBC per acre. The results of these tests were good, but other evaluations indicated that higher ratios of TCBC, or possibly other compounds, might be used to make a superior product.

In 1959, CDAA at 2, 3, and 4 pounds per acre was combined with 5, 7.5, and 10 pounds per acre of trichlorobenzyl chloride or trichlorotoluene; or with the one rate of 0.5 pounds of 2,3,6-trichlorobenzoic acid. All of these combinations were tested at six locations across the corn belt, Minneapolis, Minnesota; Kanawha, Iowa; Ames, Iowa; Columbia, Missouri; Urbana, Illinois; and Lafayette, Indiana. The tests were of a randomized block design with 3 replications at each location, and designed to provide results that could be statistically evaluated by a computer. Of the three chemicals tested as additives, TCBC was selected not only on the basis of its effectiveness, but, in addition, on its crop tolerance, lower cost for the farmer, lack of crop and soil residue, and ease of formulation. The 3-7.5 ratio was selected as the most economical ratio at which commercially acceptable weed control was obtained. On this basis, the 3 pounds of CDAA and 7.5 pounds of TCBC rate was selected for commercialization as Randox T. Observations and yield data have shown no injury to corn and rates as high as five times the recommended rates did not cause a toxic soil residue.

Randox T has for several years also shown promise as a herbicide for weed control in onions and canning peas at the Minnesota station. Other stations have indicated this product to show promise for weed control in carrots, lima beans, pole beans and crowder peas.

The acute oral toxicity of Randox T to rats is approximately ½ that of 2,4-D. However, just as Randox, it is irritating to skin and eyes. Randox T, both emulsifiable and granular, should be handled with the same precautions as are used for Randox.

The U.S.D.A. is reviewing a Randox T petition for label clearance on a no-residue basis for use in corn, as extensive crop analyses have shown that there is no residue left in or on the plants. If label clearance is obtained, Randox T will be made available in 1960 in both a liquid and a granular formulation.

Randox T can *not* be used for weed control in soybeans. It is quite toxic to soybeans as a pre-emergence treatment, causing a severe stunting of the plant with no yield of beans.

[1] Registered trade-mark of the Monsanto Chemical Company.

[2] Development Department, Monsanto Chemical Company, St. Louis, Missouri.

[3] Many people have contributed to the results reported in this paper, but especial acknowledgement is due to Mr. Robert A. Conkin of our Agricultural Research Laboratory who devised and carried out the meticulous analyses for crop residues. Credit should also be given to Drs. L. H. Hannah, J. M. Deming, and C. L. Wilson for portions of the field data reported.

"RANDOX[1] T" A NEW CHEMICAL WEED CONTROL MIXTURE FOR CORN[2]

K. L. Godfrey and P. C. Hamm[3] [4]

CDAA ("Randox") has found widespread acceptance for controlling annual weeds, especially grasses, in corn, onions, soybeans, and other resistant crops. Efforts to combine 2,4-D with Randox to increase the number of weed species controlled in corn have not been too successful because of the sporadic crippling of corn with 2,4-D used as a pre-emergence spray. Therefore, Monsanto began looking for other adjuvants for Randox which would increase the number of weed species controlled.

Among the chemicals screened by Monsanto, trichlorobenzyl chloride (TCBC) effectively improved the over-all weed control in corn without injury. It had two other attributes in its favor. 1. It could be used as the vehicle or solvent for CDAA; 2. It was potentially inexpensive to make. The ability to substitute for the concentrate vehicle for CDAA as well as provide additional weed-killing power encouraged us to expand our testing of this formulation.

Trichlorobenzyl chloride is a white to light straw-colored liquid at all usable temperatures and insoluble in water. It is miscible with CDAA in all proportions. A variety of concentrates containing CDAA and TCBC have been made and evaluated. Numerous emulsifying systems have been studied. A combination of CDAA and TCBC has resulted in a new Randox herbicide which is designated Randox T. Effective weed control in corn is accomplished over a relatively wide range of combinations.

The results in Table 1 were obtained from greenhouse tests conducted by standard procedures. Observations were made on the 14th day after planting.

Table 1. Herbicidal ratings of CDAA and mixtures of CDAA and trichlorobenzyl chloride on various grasses and broadleaf plants

Species tested	Herbicidal ratings* Test chemical, rates, lb/A		
	CDAA 4	CDAA 4+ TCBC 6	CDAA ½+ TCBC 1
Morning glory	0	3	3
Radish	0	2	1
Sugar beet	3	3	3
Pigweed	3	3	3
Soybean	0	2	3
Wild buckwheat	1	3	0
Tomato	0	3	3
Pea	0	2	0
Wild oat	3	3	3
Bromegrass	3	3	3
Ryegrass	3	3	3
Foxtail	3	3	3
Crabgrass	3	3	3
Sorghum	3	3	1
Corn	0	0	0
Leek	0	1	0

*Herbicidal ratings from greenhouse tests: 0-25% germination and survival=3; 26-50%=2; 51-75%=1; 76-100%=0.

Although CDAA effectively controls pigweed and lambsquarters, Randox T improves the killing ability at lower rates. CDAA is very effective for crabgrass and foxtail. Randox T retains and enhances this activity. The combination improves the over-all performance. The activity of Randox T on wild buckwheat is superior to CDAA.

Table 1 indicates no toxicity to peas from Randox T. Actually there is an initial slight malformation but from preliminary tests peas appear to be one of the few plants able to recover completely and grow normally. Field

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results in Minnesota with Randox T indicate excellent weed control with little or no injury to peas. Table 1 also indicates that leeks are quite resistant.

The injury on most broadleaf plant species consists of hormone-like malformations of stems, leaves, and growing point. Susceptible plants are severely stunted and gall formation and witches-broom-like malformations are common. The rate of injury progression on many plants is slower than that of 2,4-D, yet appears more tenacious. Once a plant shows incipient injury to Randox T, it is seldom able to recover completely and grow at a normal rate. Susceptible plants may emerge, absorb enough chemical to cause malformation and stunting, and remain green and alive for two weeks to a month before succumbing. This slow killing is more noticeable in greenhouse tests than in field tests.

It is believed that Randox T will perform well under minimum moisture conditions, yet will provide good control under quite wet conditions as well. Greenhouse results indicate good control of a wide number of objectionable plant species.

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[1] Trademark of Monsanto Chemical Company.

[2] Paper offered too late to appear on the program.

[3] Monsanto Chemical Company, Organic Chemicals Division, Research Department, St. Louis, Missouri.

[4] The help of D. B. Mackenzie and J. H. Nolan in preparing the herbicidal tests is gratefully acknowledged.

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PRESENTATION OF AWARDS

Mr. H. T. Richards of the Wisconsin Department of Agriculture reported for the Regulatory section that the winner of the award for outstanding County Regulatory Worker had been made to Mr. Elmer J. Slack, P. O. Box 788, Madison, Lake County, South Dakota. A summary of his report follows.

Mr. Slack, a native of Delaware, was born and reared on a farm. While living in Delaware he farmed and later worked for the Sealtest Division of National Dairies of Wilmington. He served in the U.S. Army. In 1953 he moved to Madison, South Dakota, and since then has assumed the duties of Lake County Weed Supervisor. Mr. Slack, wife and son reside in Madison where he is active in both church and community affairs.

Mr. Slack's work is a full-time job under the supervision of the County Weed Board. As a part of his regulatory and enforcement activities this past year, he made 463 calls concerning noxious weeds and served, when necessary, notices on land owners or renters to destroy them.

He conducted 13 weed control educational meetings, 3 weed control demonstrations, 6 weed tours and made 150 calls to assist farmers with weed identification and control.

Approximately 90,000 acres of crop and pastures were sprayed the past year in Lake County plus 420 miles of roadside and 6 miles of railroad or public utilities rights of way.

Strong in the belief of education through information, he assisted in the writing of 105 newspaper articles, 20 radio or TV programs and preparation of 4 weed exhibits which were set up at the local seed show, county crop improvement show, weed office and South Dakota State Fair.

Mr. Slack held 6 meetings with chemical dealers plus many individual visits. He made 12 contacts with state and county officials and utility companies regarding weed control problems.

He has promoted the practice of grain cleaning and the use of certified seed as part of a good weed control program and the use of certified seed as part of a good weed control program and was the official sealer for the South Dakota State Seed Certification Service in Lake County.

Professor Don Peterson of the Department of Agronomy, University of Wisconsin, Madison, reported for the Extension section that the award for Outstanding Extension Worker had been made to Mr. Donald Hasbargen, Austin, Mower County, Minnesota. A summary of his report follows.

Mr. Hasbargen graduated from the University of Minnesota in 1949 and immediately entered extension work. He has served in three counties and has been the county agricultural agent in Mower County since March, 1955. He was active in FFA and 4-H Club work and received the highest FFA award, The American Farmer Degree, in 1944. Mr. Hasbargen, wife and 4 children live in Austin, Minnesota.

Mr. Hasbargen has been active in county weed control work since he began his extension career ten years ago. His activities for the current year were as follows:

Participated in 8 Method and Result demonstrations in weed control;

Conducted, or participated in 37 weed promotion, identification or control meetings;

Conducted five separate tours of demonstration plots;

Prepared and distributed 23 news stories;

Conducted three training schools for sprayer operators;

Organized exhibits and made 61 individual farm or home weed control contacts.

He has 4-H Club members carrying weed identification projects. Weed collections were exhibited at local fairs. Mr. Hasbargen conducted 2 meetings with chemical dealers and made personal contact with most chemical dealers in the county. In addition to the above mentioned activities he conducted 3 sprayer clinics and in all cases worked closely with his local weed control officials. During this past season he spent an estimated 35 days on weed control work alone.

Mr. Wm. Lobay, Alberta Department of Agriculture, Edmonton, reported for the Essay Contest Committee that the 1959 essay contest winner was Gary Biskeborn, 16 years old, Chamberlain, South Dakota. His essay follows.

"HOW WE CONTROL WEEDS ON OUR FARM"

Gary Biskeborn

Weed control is as important on the farm today as raising a crop itself. It proposes a challenge and some thinking to meet it. We on our farm have tried to meet this challenge. I am going to relate to you the history, the present and future of our farm in relation to weed control.

When my father and grandfather moved to the farm in 1919, they found weeds already started in the fairly new broken sod and the pastures. There were creeping jenny (field bindweed) plants scattered in small patches here and there in one section of the farm. They planted alfalfa on this ground not realizing what kind of weed it was. Assuming it was another variety of morning glory, they fed it to the cattle and thought nothing of it until they noticed the weed was spreading rather rapidly across the farm.

This spreading took place during the twenties, and about 1930 the weeds were beginning to show up very noticeably. In these ten years the cockleburs were spreading also. It was time to do something and fast. Soil sterilant chemicals were just beginning to be used, and they decided to try them. They seemed rather expensive at first, but as we all know, weeds are more expensive to keep than to kill. They used summer fallowing along with sodium chlorate for several years. During the early thirties, the jennies were brought under control and most patches completely eliminated.

The jennies didn't both bother much again until around 1945 after a couple of good years. Why did the weeds bother then at all? Evidently the seeds had lain dormant in the ground the better part of ten years. My father felt he was back where he started. We then knew that controlling them enough so that a crop could be grown was not enough. There had to be complete eradication of the weeds, especially noxious weeds.

During the last fifteen years, the extensive weed control we have carried out has proved effective for us. In our weed control program, we use cultivation in row crops, chemicals and clean seed. Our greatest problem is finding time to take care of the weeds at the right time, especially in a dry year, when care is needed most. We always sow small grain seed that is one hundred percent free of noxious weed seeds.

Cultivation of row crops may sound rather elementary, but we think there is quite a trick to this too. For instance, the weeds may be coming up as soon as the corn, or the corn may be getting off to a slow start. A person is likely to wait until the corn is plenty big for

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the first cultivation, so he can get the job done in a hurry. We cultivate corn as soon as it is large enough, to get the weeds in the early stages of growth. The purpose is to kill the weeds before they take the moisture that is available. In the past year, it was especially important to cultivate early if any corn was to be raised at all. In the second cultivation, we throw the soil in to get all the weeds in the row.

We use chemicals extensively in many ways. When the small grain has come up and is in the five-leaf stage, we spray it with 2,4-D. The small grain has resistance to it, and the weeds are usually quite susceptible. If we have time, we do the spraying ourselves, using a two-wheel cart carrying two twenty-foot booms. Usually, however, we hire a commercial airplane weed sprayer. We sometimes have to spray in the stubble after harvest, but fall plowing or fallowing usually takes care of the weeds then. We use the same principle on the pastures and find that one spraying will keep the weeds down the rest of the year.

Each year we cover about ten miles of fence line, spraying along the fence itself. We sometimes spray into the adjacent field if it has a noxious weed in it. Our worst offenders along fence lines are kochia, and they may have to be sprayed several times a year.

We have made use of soil sterilants for several years in the corn field and plowed stubble ground. My first memory of weed control is walking down the corn row carrying a little bucket full of chemical and spreading it on the jenny patches. Now the patches are few and far between, so that we can carry the chemical on the tractor or machinery. In early May before or during listing, we apply dry chemicals on the creeping jennies. This operation follows in succession through the first and second cultivation and at picking time, each time getting the plants we missed before. This system has considerably reduced the size of some patches and completely eliminated others. We also use 2,4-D to spray the jennies and the sunflowers and cockleburs.

We try to pull the remaining cocklebur and sunflower plants after cultivating time and burn the missed plants at picking time. Sometimes we can pick a half day and not see a single plant. When we do find one, we bend it to the ground, spray furnace fuel on it and burn it.

Our future plans are to continue with and improve our present weed control methods. We will be alert for articles in farm magazines and extension pamphlets for new methods of weed control. We plan to attend the county and state weed board meetings and cooperate with the county and state weed boards.

We have found that the use of clean seed and that killing a weed before it gets a foothold is the most practical and efficient method of weed control.

Mr. R. L. Warden of the Dow Chemical Company, 1750 Hennepin, Minneapolis, Minnesota, reported for the Committee on Honorary Membership that the 1959 honorary membership had been awarded to Dr. Earl A. Helgeson of North Dakota State College, Fargo. His remarks in announcing the membership and presenting a scroll to Dr. Helgeson follow.

It is our pleasure today to welcome the newest honorary member of our conference.

Our newest member was born in Iowa in 1897. He completed high school in Oregon and received his Bachelor of Science degree from Oregon State College. The Ph.D. degree in plant physiology was completed at the University of Wisconsin, and he has been working at his present location since 1935.

At his present location he has been doing weed control work since his arrival, and he certainly must be considered a pioneer in the field. His research work has crossed many lines of weed control, and he has seen and helped to bring about a great many changes in the field since the oldest of the soil sterilants was introduced and inorganic iron and copper salts were the only selective herbicides. In addition to his work with modern-day herbicides and his genuine concern over the specific weed problems of his state, he has conducted a large number of studies into the physiology of weedy plants. A great many of his studies have dealt with the dormancy of seeds and vegetative portions of perennial weeds.

Our honorary member has distinguished himself with a large number of publications dealing with our subjects, as well as other subjects in his field. He has left his tracks in another part of the world where he spent some time as a scientific advisor on weed control problems. In his present position he is a man with several hats. He has administrative and teaching responsibilities, as well as research duties. He has been an excellent teacher, as adjudged by the fact that a high portion of his students have gone on to do very well in the world, and by the fact that one of his sons will be following in his footsteps as a plant physiologist.

"Doc" has had a major influence on the development and activities of the North Central Weed Control Conference. He is virtually a charter member and has been secretary, vice president and president of the organization. In addition, he belongs to quite a number of professional societies and has held important posts in a number of them. In his home institution when somebody mentions the word "Doc," no one needs to ask who, because he is just that well known.

In view of his many years of service and his many important contributions to weed control and to the North Central Weed Control Conference, Dr. Earl A. Helgeson is hereby awarded an honorary membership in the North Central Weed Control Conference. It is a distinct pleasure and privilege to present this scroll on behalf of the North Central Weed Control Conference and to offer congratulations on a job well done.

HONORARY MEMBERS NORTH CENTRAL WEED CONTROL CONFERENCE

These are the Honorary Members of the NCWCC.

1948	L. W. Kephart
1949	A. H. Larson
1950	J. Walter Zahnley
1951	Posthumous citations of T. R. Yost and R. F. Fuelleman
1952	Henry E. Wood
1953	Walter C. Dutton, George Briggs
1954	A. L. Bakke
1955	C. J. Willard
1956	R. S. Dunham
1957	P. J. Olson
1958	L. W. Melander and posthumous citation of T. K. Pavlychenko
1959	E. A. Helgeson

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RESOLUTIONS

NORTH CENTRAL WEED CONTROL CONFERENCE INC.

1959 Winnipeg, Manitoba

WHEREAS, the passing of Mr. Kenneth Keith has deprived the NCWCC of a competent and valued worker and

WHEREAS, we individually and as a Conference organization will miss him and his support of our work, therefore be it

RESOLVED, That we express our deep regret at his passing and extend to his family and close business associates our deepest sympathy; and be it further

RESOLVED, That this resolution be placed in the minutes of this organization and that the Secretary be instructed to transmit a copy of this resolution to his family and to the Spencer Chemical Company.

WHEREAS, the NCWCC appreciates the arrangements that have been made and the excellent facilities provided for this 16th annual meeting, now therefore, be it

RESOLVED, That we express our thanks to the Province of Manitoba, the city of Winnipeg, the Local Arrangements Committee, under the direction of the chairman, H. A. Craig, also to Mrs. H. J. Mather and her aides for organizing and carrying out an outstandingly successful ladies program, and to the Line Elevators Farm Service for providing a well executed printed program. Furthermore, be it

RESOLVED, That the Conference expresses its thanks to all others who have participated in making this Conference program a success.

The following resolution for control of noxious weeds on land under the control or jurisdiction of the Federal Government was adopted first by the Regulatory Section, and then adopted by the Board of Directors of the NCWCC:

WHEREAS, any intensive effort by crop and livestock producers to suppress noxious weeds is largely nullified in many areas by reinfestation from Federally owned and controlled lands; and

WHEREAS, the Federal Government exercises jurisdiction over many areas contiguous to farm and grazing areas, sometimes exceeding one-third of the land area in midwest and western states, and consequently should properly recognize its responsibility as a land owner to cooperate with the organized efforts of state, county and local weed control programs; and

WHEREAS, the North Central Weed Control Conference at Chicago, Illinois, in 1956, recognized the seriousness of this problem and adopted a resolution asking Congress to adopt legislation to correct this situation; and

WHEREAS, the North Central Weed Control Conference at Cincinnati, Ohio, reaffirmed their stand on this proposed legislation; and

WHEREAS, the 40th Annual Convention of the National Association of State Departments of Agriculture meeting at Madison, Wisconsin, September 29 to October 3, 1958, resolved that Congress should undertake by legislation to require that every department, agency and independent establishment in the executive branch of the Federal Government having control of, or jurisdiction over, land located in any state, shall comply with all laws and regulations of each of the several states providing for the control of noxious weeds in the same manner that other landowners are required; therefore, be it

RESOLVED that we assembled here at the North Central Weed Control Conference in Winnipeg on December 10, 1959, again reaffirm our stand on said legislation and urge adoption by the 86th Congress of the needed legislation to accomplish the objectives above stated.

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Meetings of the Board of Directors

Royal Alexandra Hotel. Winnipeg, Manitoba

Abstracts of the Minutes

December 8, 1959

The meeting was called to order at 3:30 p.m. by President Roe Foster. Industry, the three provinces of Canada, ten states, and five directors at large answered roll call. Directors from Illinois, Michigan, Nebraska and Oklahoma were absent.

The Treasurer's report showed that there was a deficit of $1721.01 in conference operations. The Treasurer was instructed to check on the commitments of the conference in regard to scholarships.

Committees on Local Arrangements (H. A. Craig), Program (L. G. Holm), Terminology (L. G. Holm), and Industry (R. L. Warden, for M. B. Turner), made brief reports.

Don Peterson, for Extension, H. T. Richards, for Regulatory, and R. L. Warden, for Honorary Membership, reported the awards to be given Wednesday evening (Pages 57-58), which were approved.

Lyle Derscheid, for the Nominations Committee, reported the nominations of J. D. Furrer for Secretary-Treasurer, E. K. Alban for Vice-President, and L. G. Holm for President. There were no other nominations, and these men were unanimously elected.

D. D. Hemphill, for the Research Committee, reported the preparation of a Supplement to last year's Research Summaries, and a "Classification of Weed Plants as to Susceptibility to Herbicides." It was voted to include these in the Proceedings.

K. P. Buchholtz reported for the committee on revision of the by-laws, presenting a tentative set of by-laws and a procedure for considering them. After considerable discussion and some changes, the By-Laws as printed on Page 61 were adopted.

Fred Warren reported for the Future Meetings Committee that Michigan had requested us to cancel the 1960 meeting at East Lansing. Wisconsin has invited the Conference to meet at the Schroeder Hotel at Milwaukee in 1960. This invitation was accepted.

The 1961 meeting will be in St. Louis, when the NCWCC will be host to the WSA.

Minnesota invited the Conference to the Twin Cities in 1962. The Board voted to meet at the Lowry Hotel in St. Paul, preferably during the week of December 3.

Following considerable discussion of weed loss data, which was finally referred to the Research Committee, the Board adjourned.

December 9, 1959

The Board of Directors meeting was called to order by President Holm. Roll call of the new directors showed the following absent: Alberta, Illinois, Michigan, Oklahoma, Past President, and Research.

Directors from Wisconsin reported that the 1960 meeting would be early in the week of December 11.

The Board voted to meet December 4 and 5 or 5 and 6, 1962, at St. Paul, at the discretion of the local committee.

Sig Bjerken reported the resolutions printed on Page 59, which were adopted.

The Industry Section reported two resolutions, which were accepted by the Board:

1. That no special solicitations be made for a social hour—the expense, if incurred, to be met out of regular income.

2. That amounts contributed to the social hour in 1959 be recognized as membership fees in the NCWCC for 1959.

Payment of the Editor's expenses to the meeting, and payment of $250 for secretarial help on the 1959 Proceedings, were authorized.

The resolutions printed on Page 59 were offered by the Resolutions and Necrology Committee, and adopted.

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Bylaws of the North Central Weed Conference, Inc.*

Bylaw I. Purpose

This conference, incorporated under the laws of the State of Iowa, is established to bring together representatives of the North Central area of the United States and Canada and agencies, institutions and persons who are directly interested in or engaged in weed control through research, education, regulation, and merchandising. The purpose is to facilitate the exchange of ideas, experiences, opinions and information, and discuss and plan means of securing more adequate weed control through more and better correlated and coordinated effort on weed research and control by Federal, Dominion, State, Provincial, and local public and private agencies.

Bylaw II. Membership and Dues

Section 1. **Membership** shall be of four (4) kinds: (a) state or provincial, (b) active, (c) industrial organization, and (d) honorary. Active and industrial organization memberships shall be for the term for which the dues or fees are paid and shall become effective upon the payment of the dues or fees. Such members shall be considered in good standing until the next term's dues are unpaid.

Section 2. **State or provincial membership.** The members shall be Alberta, Illinois, Indiana, Iowa, Kansas, Kentucky, Manitoba, Michigan, Minnesota, Missouri, Nebraska, Ohio, Oklahoma, North Dakota, Saskatchewan, South Dakota, and Wisconsin. Other states, provinces, or other legally established divisions of the United States or Canada may be admitted to membership by a two-thirds vote of the board of directors. There shall be no dues in this category.

Section 3. **Active membership.** Active membership shall be available to all those who have an active and sustained interest in some phase of weed control and who reside in states and provinces that have membership in the conference. The dues and/or registration fees for active members shall be determined by the board of directors prior to each conference meeting.

Section 4. **Industrial Organization membership.** Industrial organization membership shall be open to firms who are engaged in the manufacture or sale of materials, equipment, or services for weed control. These members shall constitute the industrial section of the North Central Weed Control Conference. The number of voting representatives in the section allowed each member firm shall be determined by the industrial section. The Chairman of the industrial section shall be a member of the Board of Directors of the North Central Weed Control Conference. The minimum membership fee of the industrial section shall be $15.00 per organization. A list of the members of the industrial section shall be included in the Proceedings of each conference meeting.

Section 5. **Honorary membership.** Honorary membership may be conferred on persons of distinction who have made outstanding contributions to weed work. Honorary members shall be selected by a two-thirds vote of the board of directors on recommendation of a special committee to consider such nominations. They shall not be liable for dues.

Bylaw III. Governing and Voting

Section 1. **Directors to govern.** The government of this conference shall be vested in a board of directors, which shall consist of the officers, the director for each state, province, or other legally established division and six (6) directors at large consisting of the chairmen of the Regulatory, Extension, and Research Committees, the Chairman of the Industrial Organization Section, a representative of the Research Branch, Canada Department of Agriculture, and the immediate Past President of the North Central Weed Control Conference.

Section 2. **Selection of directors.** The incumbent director shall poll representatives of such sections (regulatory, extension, research, and industrial) as are active in his state, province or other agency not later than the opening day of any conference, to select a director and an alternate director for the ensuing term. The method of voting shall be decided by those voting.

Section 3. **Term of office.** Directors shall assume office on the last day of a conference and shall serve until the last day of the succeeding conference, or until their successors have been selected and duly qualified. No state or provincial director shall serve for more than three (3) consecutive terms.

Section 4. **Voting.** A majority vote is required in all cases except as otherwise provided. Voting by directorship shall be recorded by the Secretary.

Section 5. **Voting between meetings.** Voting between meetings of the directors may be conducted by the President or Secretary-Treasurer by mailing ballots to all directors and notifying them of the purpose of the vote. The call for the vote shall specify a reasonable deadline for the return of the ballots.

Bylaw IV. Officers

Section 1. The officers of the conference shall be a President, a Vice-President, and a Secretary-Treasurer, elected by the outgoing board from the active membership of the conference. New officers shall assume office on the last day of a scheduled conference and shall serve until the last day of the succeeding conference or until their successors have been selected and duly qualified.

Section 2. Duly elected officers become members of the board of directors. The president shall act as chairman of the board.

Bylaw V. Meetings

Not later than each meeting, the time and place for the next meeting shall be determined by the board of directors, acting on the suggestions of a future meetings committee.

Bylaw VI. Quorum

Section 1. Two-thirds of the board of directors shall constitute a quorum for transaction of business at any meeting.

Section 2. When voting by mail, ballots shall be sent to all directors. A majority vote of those replying within the specified time limit shall decide the question.

Bylaw VII. Rules of Order

Roberts' Rules of Order shall govern the conduct of all meetings.

Bylaw VIII. Amendments

The Bylaws may be amended by two-thirds vote of the board of directors at any meeting provided previous notice in writing has been given to the directors of the proposed amendments at least thirty (30) days prior to the date of the vote.

*Adopted by the Board of Directors at its meeting on December 8, 1959.

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RESEARCH REPORTS

NORTH CENTRAL WEED CONTROL CONFERENCE, INC.

1959

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RESEARCH COMMITTEE NCWCC, 1959

E. K. Alban	Department of Horticulture, Ohio State University, Columbus, Ohio
R. N. Andersen	Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minnesota
L. E. Anderson	Department of Agronomy, Kansas State University, Manhattan, Kansas
R. H. Beatty	Agricultural Chemicals Research, Amchem Products, Inc., Ambler, Penn.
R. Behrens	Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minnesota
K. F. Best	Dominion Experiment Station, Swift Current, Saskatchewan, Canada
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CONTROL OF HERBACEOUS PERENNIAL WEEDS

JOHNSONGRASS

Johnsongrass control by fall applications of dalapon to regrowth. Anderson, L. E. A uniform stand of Johnsongrass was mowed August 22, 1958, and burned when throughly dry. Regrowth, which had reached a height of 10-14 inches, was sprayed with dalapon at a rate of 15 lb/A on September 12. The area was plowed October 20 and sown to winter wheat October 23. The wheat germinated uniformly and emerged with no evidence of injury from dalapon residues in the soil. Spring growth of wheat in the treated area compared favorably with wheat growing in adjacent fields that were untreated; there was no apparent reduction in yield. With favorable growing conditions that existed in the fall of 1958, the late application of dalapon on regrowth resulted in excellent control of Johnsongrass in the spring and summer of 1959. Only a few scattered plants were found in the treated area. (Contribution of the Kansas Agr. Exp. Sta.)

EPTC for control of Johnsongrass. Freeman, J. F. Heavily infested creek bottom land in Franklin county had the Johnsongrass mowed at early-dough stage of the seed, and the growth raked and burned prior to breaking and fitting the land the first week in July 1959. On July 10 quadruplicate plots 8′ x 26.5′ were sprayed with EPTC at 0, 3, 6, 9, and 12 lb/A in 28.5 gal/A water. Plots were rototilled to incorporate herbicide with the soil to a depth of 4-6 inches, as soon as spraying was completed. Soil was dry at time of treatment and remained dry until a period of heavy rainfall a week later. The number of Johnsongrass plants from rootstocks and seedlings in an area 4′ x 22.5′ in each plot was determined September 1 with results as follows:

EPTC, lb/A	Rootstock plants	Seedlings	Annual grasses
0	17	61	87
3	8	4	5
6	2	3	4
9	2	1	0
12	1	1	0

Corn planted in each plot 3 weeks after treatment emerged full stand and without evidence of injury at any rates of treatment. Corn planted 3 days after treatment emerged poorly on plots receiving EPTC at 6 lb/A and higher rates, and with considerable injury at 3 lb/A. In a similar experiment at Lexington a moderately heavy stand of Johnsongrass was plowed under May 30, 1959 when plants were 10 to 15 inches high. The stand had been established by seeding Johnsongrass in June 1958 hence the soil was not infested with the seed. Heavy rains after plowing delayed treatment of plots until June 8 at which time the land was thoroughly worked with a field cultivator and EPTC applied at same rates and incorporated with soil as already described for the Franklin county experiments. After treatment there was no rain for 2 weeks. On July 24 the number of Johnsongrass plants (mostly from rootstocks) was determined in each 9 x 28-foot plot. Based on the untreated check, which had 31 plants, reduction in number of plants for EPTC, 3 and 6 lb/A, was 56 and 85% respectively. Reductions for 9 and 12 lb/A rates were no greater than that for the 6 lb rate. Emergence of corn planted 9 days after treatment was excellent and plants showed little or no phytotoxic effect for EPTC at 9 lb/A and lower rates, whereas emergence of corn planted 2 days after treatment was reduced, and/or phytotoxic effects were severe at the 6 lb and higher rates. (Department of Agronomy, Kentucky Agr. Exp. Sta.)

The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director.

Pre-plowing, foliage treatment of Johnsongrass with herbicides for control in corn. Freeman, J. F. The new herbicide 2,3,6-trichlorophenylacetic acid (Fenac), which was reported in 1958 as suitable and effective for this type of use in quackgrass-infested land being planted to corn, was compared with sodium salt of dalapon for Johnsongrass control in quadruplicate plots each 7 x 23 ft at Lexington in 1959. Johnsongrass from rootstocks of plants established in 1958 was sprayed June 16, 1959, when plants were 12 to 24 inches tall. Treatments were: Fenac-sodium salt, 2, 4, and 8 lb/A; dalapon 3¾, 7½, and 11¼ lb/A, each in 32 gal/A water; and untreated. One week after treatments were applied Johnsongrass was plowed under with a mold-board breaking plow and the land disked thoroughly 3 days later. Corn, Ky 105, was planted on portions of each plot 11 days, 17 days, and 25 days after treatments were applied. The number of Johnsongrass plants, the number of other weeds in 4′ x 20′ area of each plot and number of normal and injured corn plants from each date of planting in smaller sub-plots were determined the last week of July. Based on the check, which had 64 Johnsongrass plants (all from rootstocks) in 80 sq ft, herbicide treatments resulted in reductions as follows: Fenac 2, 4, and 8 lb/A, 17, 35 and 62% respectively; and dalapon 3¾, 7½, and 11¼ lb/A, 86, 87, and 88%. Number of annual weeds emerging was not affected by treatments. Only Fenac 8 lb/A in the first planting date resulted in reduced stand of corn. All rates of Fenac in first planting date and 8 lb/A rate in 2d planting date resulted in injured plants. Forty percent of plants in plots treated at 8 lb/A in the first planting date were epinastic. (Department of Agronomy, Kentucky Agr. Exp. Sta.)

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Control of Johnsongrass seedlings in corn rows where effective rootstock control practices were used in two preceding years. Freeman, J. F. and Smith, E. M. As a follow-up to effective Johnsongrass rootstock control in 1957 and 1958 in an experiment on heavily-infested creek bottom land in Franklin county (see Ky. Agr. Exp. Sta. Progress Report 78) pre-emergence chemical treatments and flame cultivation were used to control seedlings and escaped rootstock plants in the row of corn planted in 1959. The 1959 experiment was superimposed on an area where plots, treated initially in 1957 with dalapon, TCA, or HCA, were summer-fallowed or sprayed at 1 month intervals with dalapon plus 2,4-D in 1958. In mid-June 1959, prior to breaking the land for corn, random sampling indicated less than 2 rootstock plants/10 sq ft. Corn was planted July 1 and 2, 1959. Quadruplicate four-row plots 350 ft long were treated as follows: EPTC, 1½, 3, 4½, and 6 lb/A in 58 gal/A solution, solid coverage basis, incorporated with soil 3″ deep; the same rates—surface applied; flame cultivation of rows 1 month after planting and repeated 8 days later; and untreated check. EPTC sprays were applied in 13⅓-inch bands centered over 40-inch rows, hence the actual rate was only ⅓ the solid-coverage rate. Spray treatments were applied as corn was planted with a 2-row, tractor-mounted planter, the EPTC-incorporated treatments being sprayed ahead of the planter shoe with a nozzle mounted in front of a reversed rotary hoe row-attachment, and EPTC-surface treatments with a nozzle mounted at rear of the planter press-wheel.

Soil was dry at planting time and continued so for 2 weeks, resulting in delayed emergence of corn and somewhat irregular stands even on the unsprayed treatments. Middles were cultivated to control Johnsongrass and weeds between rows. The number of Johnsongrass plants in the rowbands of each plot was determined September 8. Based on the untreated check, which had 165 plants (1% from rootstocks) in 350′ of row, EPTC

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incorporated at 1½, 3, 4½, and 6 lb/A reduced the number 92, 98, 99, and 99+% respectively; the same rates, surface applied, reduced the number 90, 93, 98, and 98%; and flame cultivations reduced the number 77%. Due to the immaturity of the corn it was ensiled and yields were not obtained. Stand of corn was reduced and percentage of small or injured plants was increased where EPTC treatments were used. Based on the untreated check, reduction in number of corn plants per row as the mean for all rates of EPTC, incorporated, was 23%, and for all rates, surface applied, was 9%. Similar means for increase in number of small or injured plants were 34% and 23%. Dry soil conditions at time of and following planting delayed emergence, and probably contributed to the severe crop injury by EPTC treatments in this experiment. In a similar experiment in the same field where corn was planted and treated June 10, with soil moisture conditions favoring prompt emergence and establishment of the crop, there was little difference in stand or number of small or injured plants for the untreated check and 3 and 6 lb/A rates of EPTC. (Departments of Agronomy and Agricultural Engineering, Kentucky Agr. Exp. Sta.)

The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director.

Herbicides for spot treating Johnsongrass in corn rows. Freeman, J. F. On July 3, 1959, corn was planted in an area of bottomland soil, Franklin county, where Johnsongrass rootstocks had been fairly well controlled by a combination of herbicides and cultural practices during 1957 and 1958. Seedlings and escaped rootstock plants were spot treated in the rows of quadruplicate plots, 4 rows wide and 65 feet long, using: kerosene; C-56 (hexachlorocyclopentadiene) at 10 and 20 ml/gal kerosene; HCA at 190 and 380 ml/gal kerosene; sodium salt of TCA at 1 lb/gal water; sodium chlorate, dry. The spray solutions were applied with hand sprayer (Texas jet gun) to the basal parts of the plants, and the sodium chlorate was applied to soil with a Mason jar having a perforated metal top, used like a salt shaker, within a 5-inch circle about each seedling plant and within 10-12 inch circles about each escaped rootstock plant (av. 1 gm/plant).

Kerosene and kerosene + C-56 or HCA sprays were applied August 31, and repeated September 8, and September 16; TCA and sodium chlorate were applied once only, August 31. Corn was 1 to 2 ft tall and Johnsongrass was emerging to 1 ft tall at time of initial treatments. Corn was shielded during application of spray treatments and there was little injury to corn from any of the herbicide treatments. The number of Johnsongrass plants within the 10" band of each row was determined September 1, near time of initial treatment and again September 30, two weeks after final spray treatment. On the untreated check the number had increased from 27 plants (5 from rootstocks) in 65 ft of row to 31 plants (6 from rootstocks) while the number on herbicide treatments was reduced as follows: Kerosene, 88%; C-56, 10 and 20 ml/gal kerosene, 86 and 91%; HCA, 90 and 180 ml/gal kerosene, 86 and 92%; TCA, 1 lb/gal water, 71%, and sodium chlorate, 1 gm/plant (approx.), 89%. Control by herbicides was greater than these percentage figures indicate because some plants emerged during the month following initial treatments as evidenced by the 12% increase during that period on untreated check. (Agronomy Department, Kentucky Agr. Exp. Sta.)

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QUACKGRASS

The control of quackgrass with Atrazine. Buchholtz, K. P. Atrazine (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine) was applied to plots 15 by 20 feet, located in an old, heavily-infested quackgrass sod. Applications were made at rates of 2, 4, and 8 lb/A on April 17, 1959, using spray equal to 20 gal/A. The soil was a Waupun silt loam of moderate fertility. Nitrogen as ammonium nitrate was applied to some of the plots at 100 lb/A at time of treatment. A second series of plots was treated with 50 lb/A of nitrogen at time of treatment and 50 lb/A just before plowing and a third series received the entire 100 lb/A application just before plowing. The area was given a broadcast application of 500 lb/A of 10-10-10 fertilizer on May 1. On May 12, the area was plowed. The soil was fitted and planted to W530 corn using a rate of about 15,000 seeds per acre. Two hundred lb/A of 6-24-24 fertilizer was drilled in the row at time of planting. Diuron was applied at 2 lb/A as an overall spray on May 27 to control annual weeds. None of the plots were cultivated during the season. Counts of quackgrass shoots were made on June 16 and on July 9 yields of quackgrass top growth were obtained from quadrats in all plots. When the corn was mature, it was harvested and yields obtained.

Atrazine lb/A	Nitrogen appl. lb/A	Quack shoots per sq ft[1]	Quack yield lb/A[1]	Corn yield bu/A[1]
2	100 late	15.9 a	208 b	89.5 a
4	100 late	12.6 a	68 ab	90.2 a
8	100 late	15.1 a	42 a	86.3 a
2	50 early & late	13.3 a	164 ab	91.8 a
4	50 early & late	10.4 a	48 a	80.5 a
2	100 early	9.4 a	152 ab	89.4 a
4	100 early	5.9 a	34 a	92.1 a
0	50 early & late	64.6	1830	33.1

[1] Values not adjacent to the same letter are significantly different at the 5% level.

The quackgrass became yellowish and the tips of the leaves started to die within a week after treatment. The injury developed most rapidly on the plots treated with nitrogen on April 17. After plowing and planting the corn, most quackgrass regrowth appeared on the plots that received the late application of nitrogen. Most of this late growth died during the late spring and early summer. The date of nitrogen application did not appear to influence the ultimate kill of quackgrass obtained. The plots treated with the 4 and 8 lb/A rate gave somewhat better control of quackgrass than those treated with 2 lb/A. Virtually no quackgrass remained in October on plots treated with Atrazine at 4 and 8 lb/A. Growth of corn was excellent on all plots receiving the Atrazine treatment and no significant differences were found. Heavy fertilization did not overcome the severe competition from the quackgrass on plots where Atrazine was not applied. (Department of Agronomy, Univ. of Wisconsin, Madison.)

Use of dalapon combined with tillage for the control of couchgrass. Carder, A. C. In late spring of 1958 dalapon was applied at different rates to a continuous infestation of couchgrass 8 in. high. The chemical was delivered in water solution at the rate of 20 gal/A from a boom plot sprayer. Three weeks later the area was double one-way disced crosswise, followed in 6 weeks with another application of dalapon when the couchgrass resprouts were 4 in. high. Further double one-way discings were given 2 weeks and 8 weeks after this treatment. The effects of the various treatments were appraised in 1959. Rates of dalapon used and results from quadruplicate plots are given in the table.

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Dalapon, lb/A			Percent survival year following treatment*	
1st applic.	2nd applic.	Total	Early summer	Autumn
0	0	0	16	33
6	6	12	5	11
8	4	12	10	17
10	5	15	8	12
8	8	16	5	9
12	6	18	5	9

*Visual estimate by same appraiser

Because of the extremely dry conditions in 1958 the 3 tillage procedures in themselves gave 84% control of the couchgrass. This is an unusually high degree of kill for so few tillage operations. However, recovery was rapid. The data suggest that where dalapon is used the second application rate should equal the first. Applied thus, a total of 12 lb/A gave 95% control. With dalapon, as with tillage, recovery set in shortly after maximum kill early in the year following treatment. (Contribution of Experimental Farm, Beaverlodge, Alberta.)

Comparative effect of fenuron and monuron when applied to undisturbed couchgrass sod. Carder, A. C. Fenuron and monuron were applied to undisturbed couchgrass sod in the spring of 1953 on quadruplicate plots at rates indicated in the table. The herbicides were knapsack-sprayed in water suspension at the rate of 80 gal/A. The grass was a foot high and in shot-blade when treated. Soil was a rather deep black clay loam.

Lb/A	Av. percent of couchgrass in given years after treatment					
	1	2	3	4	5	6
Fenuron at 20	28	82	98	100	100	100
40	7	10	23	75	93	100
80	2	0.5	0	6	18	60
100	1	0	0	5	14	46
Monuron at 40	6	9	12	29	24	58

*Visual estimates by same appraiser

As indicated by the 40 lb/A rate, fenuron and monuron showed about the same ability to kill couchgrass but the residual effect of the latter was much longer lasting. At this rate the couch in the fenuron plots had completely re-established itself after 6 years from time of treatment, while that in the monuron plots was little more than half re-established after this time. Eighty lb/A of fenuron were needed to eradicate couchgrass, but re-establishment was rapid by invasion from surrounding untreated areas. (Contribution of Experimental Farm, Beaverlodge, Alberta.)

Treatment of couchgrass with monuron alone and combined with tillage. Carder, A. C. Couchgrass on shallow black loam soil was treated in late spring and early fall of 1952 with monuron (CMU). Treatments were made after about 20 in. of leaf growth were removed and raked off. The monuron was knapsack-sprayed on duplicate plots in water suspension at the rate of 80 gal/A. Procedure and results are given in the table.

Treatment	Lb/A CMU	Av. percent* of couchgrass in given years following treatment												
		Spring treatment							Fall treatment					
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
CMU on undisturbed sod	10	15	8	12	8	15	23	30	12	5	7	11	22	28	58
	20	5	0	2	2	8	14	20	4	2	0	2	12	14	32
	40	1	0	0	0	0	0	4	2	0	0	0	11	12	28
	80	0	0	0	0	0	0	2	0	0	0	0	1	1	8
CMU, one-wayed 2 weeks later	10	18	40	48	62	80	50	82	65	32	38	42	48	36	55
	20	10	6	6	8	15	11	25	18	14	10	8	8	14	32
	40	5	0	0	0	4	3	11	12	6	5	5	6	11	26
	80	1	0	0	0	1	1	4	4	0	0	0	1	2	8
One-wayed, CMU applied	10	28	48	35	82	82	60	82	40	48	55	75	80	63	85
	20	15	5	2	2	11	13	28	32	15	7	10	11	19	32
	40	8	1	0	0	2	3	11	15	1	0	0	6	5	14
	80	2	0	0	0	2	2	4	12	0	0	0	1	1	8
One-wayed, CMU applied, one-wayed	10	15	25	20	32	41	33	70	40	35	38	48	60	45	78
	20	12	8	5	6	11	23	55	28	22	25	25	27	30	52
	40	5	0	0	0	3	2	6	25	14	11	15	11	16	38
	80	1	0	0	0	2	1	6	16	8	6	8	6	9	21

*Visual estimates by same appraiser

Monuron was most effective when applied in the spring on undisturbed sod. Applied thus, 20 lb/A gave complete kill although re-establishment was initiated fairly soon thereafter from surrounding untreated areas. With tillage, 40 lb/A were necessary for eradication. Where 40 and 80 lb/A were applied in the spring to undisturbed sod, couchgrass did not invade until the 7th year following treatment, while in every instance where cultivation was involved regrowth occurred in the 5th year. Fall treatments were generally less effective than those made in the spring. (Contribution of Experimental Farm, Beaverlodge, Alberta.)

EPTC (Eptam) combined with tillage for couchgrass control. Carder, A. C. In the spring of 1959 when a couchgrass sod had about 10 in. of new growth, Eptam was applied to triplicate 2-sq-rod plots by Gandy spreader at nil, 5, 10, and 15 lb/A. Application was immediately followed by double one-way discing, the second working crosswise to the first. Two months later when the grass resprouts were about 3 in. high, the area was again oneway disced twice. Appraisal in late autumn showed the following kills to have ben obtained: nil, 40%; 5 lb/A, 65%; 10 lb/A, 65% and 15 lb/A, 57%. (Contribution of Experimental Farm, Beaverlodge, Alberta.)

Control of couchgrass with cacodylic acid, Fenac and TCA. Corns, Wm. G. The growth on dense sod of couchgrass was cut on May 26, 1959 and regrowth 6-10" tall was sprayed on June 11 with the following herbicides on duplicate plots: TCA, 50 and 100 lb/A; Fenac (sodium 2,3,6-trichlorophenylacetate), 5, 15, and 30 lb/A; cacodylic acid, 5, 15, and 30 lb/A, all applied in 50 gal/A water. On July 7, about 4 weeks after treatment, half of each plot, including checks, was rototilled twice. The results on Sept. 22 are given below.

Soil treatment	Numbers of live shoots as percent of check							
	TCA, lb/A		Fenac, lb/A			Cac. acid, lb/A		
	50	100	5	15	30	5	15	30
Undisturbed	93	46	112	93	88	97	96	97
Rototilled	0.3	0	38	0.2	0.1	45	45	22

The efficiency of TCA plus cultivation, used as a standard, parallels earlier work. Cacodylic acid appears to be unsatisfactory. Fenac at 15 and 30 lb/A plus cultivation is promising but must await future observations. Fenac was outstanding in preventing growth of annual weeds on its 15 and 30 lb/A tilled areas. Rototilled plots of the other two herbicides supported healthy stinkweed, lambsquarters, and night-flowering catchfly by fall. (Division of Crop Ecology, Dept. of Plant Science, Univ. of Alberta).

Effects of Fenac foliage sprays on couchgrass, creeping red fescue and Kentucky bluegrass in the greenhouse. Corns, Wm. G. Flats of loam soil, each divided into three sections for the three species of grass for each treatment were prepared in triplicate for each rate, 0, 4, 8, and 16 lb/A Fenac (sodium 2,3,6-trichlorophenylacetate). The fescue and bluegrass were grown from seed, the couchgrass from pieces of rhizomes. The couchgrass was clipped to stimulate tillering prior to spraying. Foliage was sprayed on June 2, 1959, three weeks after commencing the test. All grasses were clipped on June 25, July 15, and Aug. 12. Observations of relative growth rates and regrowth were noted and dry matter of foliage was recorded for the Aug. 12 clipping. Bluegrass was somewhat more sensitive than fescue to the 8 and 16 lb/A rates of Fenac which also inhibited couchgrass. There was, however, no indication of useful differential selectivity. The dry matter for the Aug. 12 clipping is tabulated as percent of check:

Fenac	Bluegrass	Couchgrass	Fescue
4 lb/A	84	59	74
8 lb/A	47	31	57
16 lb/A	29	15	30

The effect on couchgrass appeared to be intensified by its lower ability than the other species to recover from

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close clipping. (Division of Crop Ecology, Dept. of Plant Science, Univ. of Alberta).

Amitrol and TBA for couchgrass control, 1959. Selleck, G. W. Applications of amitrol and 2,3,6-TBA at initial rates of 20 lb/A were applied in 35 gal water with a variable rate sprayer to duplicated, 15 x 135 ft plots July 5, 1957, on silty clay loam soil near Saskatoon. Half of the plots were sprayed, and the other half mowed. Treatments which combined spraying, mowing and tillage were continued on the same plots during 1958. The rate of application of herbicides (lb/A) necessary to provide various degrees of control in 1959 are presented below.

Treatment		Lb/A necessary to give indicated percent control				
1957	1958	100	99	95	90	85
Amitrol, cult.	2 amitrol	....	14.0	....	12.0	....
Amitrol, 2 cult.	2 amitrol	....	....	....	....	2.0
Amitrol, cult., amitrol	2 amitrol	....	10.0	7.0	....	1.5
Amitrol, cult., amitrol	3 cult.	....	....	0.6	....	....
Amitrol, TBA, amitrol	3 cult.	....	0.6	....	....	....
Mowed, 2TBA	3 TBA	5.0	....	....	....	3.0
Mowed, amitrol	3 amitrol	5.0	....	....	....	1.6
Mowed, amitrol, cult.	3 amitrol	3.2	....	2.0	....	....
Mowed, amitrol, cult.	3 cult.	0.6		(all black)		
Mowed, 2 amitrol	2 amitrol	12.0	....	7.0	5.0	....
Mowed, TBA	2 TBA	7.0	6.0	4.0	....	....

In the second year, one operation with a duckfoot cultivator appeared to be roughly equivalent to one application of amitrol at the 4 lb/A rate. Two applications at 12 lb/A appeared to be equivalent to three cultivations. Somewhat better results were obtained when couchgrass was mowed and the spray applied to the regrowth. (Contribution No. 276 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from Amchem Products Inc.)

Herbicides for couchgrass control, 1959. Selleck, G. W. Amitrol, TCA, and dalapon at rates ranging from 10 lb/A and 1 lb/A were applied to quadruplicated, 15 x 80 ft plots in 30 gal of water on silty clay loam soil near Saskatoon. All plots were sprayed May 21, with second and third applications to half of them, June 25 and Sept. 4, 1958. The other half of the plots were cultivated June 25 and Aug. 20, 1958. The plots were re-treated when couchgrass regrowth had reached a height of 3-4 in. The plots were assessed Sept. 12, 1958 and June 9, 1959. Data are given in the table as a fraction, the numerator representing the rate (lb/A) and the denominator the resulting percentage of control. Where 100% control is not listed, this degree of control was not attained even by the 10 lb/A rate.

	TCA			Dalapon			Amitrol		
	1958	1959		1958	1959		1958	1959	
3 sprayings	7/50	3.5/80	3.0/75	4.0/90 3.0/85	5.0/90 4.0/80	3.6/75	6.0/99 6.0/95	3.6/50	5.0/99 3.7/95 3.0/85
1 spray & 2 cult.	1.0/100 1.0/92	—	—	1.0/100 —	7.0/100 1.5/99	1.0/90	1.0/100 —	—	3.6/100 2.5/95 1.0/85

One spraying followed by two cultivations provided better couchgrass control than three sprayings. (Contribution No. 265 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from Amchem Products Inc.)

CANADA THISTLE AND PERENNIAL SOWTHISTLE

Herbicides for control of Canada thistle. Brown, D. A. Treatments were made in 1958. Plots were uniformly tilled in the spring of 1959 and seeded to wheat. Thistle survival counts were made in July 1959.

Stage	3-amino-1,2,4-triazole		2,3,6-trichlorobenzoic acid		
Lb/A	Survival thistles	Acre yield wheat	Lb/A	Survival thistles	Acre yield wheat
	Pct.	Bu.		Pct.	Bu.
Bud					
1½ cult.	14.5	39.7	5 no cult.	82	9.9
1½ no cult.	43.5	27.0	10 no cult.	56	5.2
3 cult.	13.7	33.4	20 no cult.	22	0
3 no cult.	37.7	31.9	30 no cult.	2	0
6 cult.	8.7	33.7			
6 no cult.	28.7	30.6			
Full bloom					
1½ cult.	49.6	18.1	5 cult.	46	12.8
1½ no cult.	72.7	12.4	5 no cult.	70	8.6
3 cult.	26.5	22.0	10 cult.	24	4.9
3 no cult.	38.3	20.3	10 no cult.	31	1.3
6 cult.	16.5	19.6	20 cult.	6	0
6 no cult.	21.5	20.0	20 no cult.	5	0
			30 cult.	0	0
			30 no cult.	0	0
Mow full bloom, treat regrowth at 6"					
1½	54.0	20.7	5	56	8.1
3	24.5	27.4	10	36	0
	7.0	30.1	20	11	0
			30	3	0
Cult. intensely	5.3	44.7		4.2	38.6
Cult. moderately	14.3	42.6		9.3	35.8

Experimental Research Farm, Brandon, Manitoba.

Combinations of herbicide and cultural treatments for the control of Canada thistle and sowthistle. Forsberg, D. E. During the fallow year of a three-year rotation the following treatments were applied after all plots were uniformly worked with a one-way in the spring of 1958: (1) 2,4-D butyl ester applied at bud stage at 1 lb/A and normal tillage resumed after 6 weeks; (2) 2,4-D butyl ester applied at the bud stage at 12 oz/A and repeated 2 weeks later, no further tillage; (3) 2,4-D butyl ester applied at bud stage at 8 oz/A and repeated two weeks later, then tilled prior to freeze-up; (4) the butyl ester of 4-(2,4-DB) applied at bud stage at 2 lb/A and normal tillage resumed after 6 weeks; (5) amitrol applied when thistles 4 to 6 inches high at 2, 4, 6, and 8 lb/A and normal tillage resumed after 2 weeks; (6) a DBM (DB granular, 39.2% boron trioxide, 7.5% 2,4-D) at ¼, ½ and 1 lb/100 sq ft (total product) applied immediately after spring tillage and tilled as required for remainder of season; (7) Borascu (sodium borate ore, 34% boron trioxide) at ¼, ½, and 1 lb/100 sq ft (total product) applied immediately after spring tillage and tilled as required for remainder of season. Observations made on the crop sown on summerfallow treated in 1958 would indicate that this BDM and Borascu cannot be used in a fallow program, as soil sterility is too great. Best results were obtained with the 6 and 8 lb/A of amitrol, resulting in 100 percent kill in all plots. All other treatments in the test resulted in very little thistle growth in 1959, although an odd plant of thistle was found in each of these plots. (Contribution by the Research Branch, Experimental Farm, Scott, Saskatchewan, Canada.)

Control of Canada thistle and perennial sowthistle in cropland. Forsberg, D. E. On June 22 the following herbicides were applied to a mixed infestation of Canada thistle and perennial sowthistle (var. *glabrescens*) in a crop of wheat that was about 10 inches high and when the thistles were 4 to 8 inches high: 2,4-D butyl ester, MCPA butyl ester, and butyoxyethanol ester at 4, 8 and 16 oz/A; 4-(2,4-DB) butyl ester applied at 8, 16 and 32 oz/A, 4-(MCPB) butyl ester at 16 oz/A. None of the treatments applied resulted in 100 percent kill of top growth. The highest top kill was obtained with the 16 oz/A rates of 2,4-D butyl ester, butoxyethanol ester and butyl ester of 4-(2,4-DB). Top growth kill ranged from 45 to 50 percent with these herbicides. Yield data indicated that these herbicides applied at the above rates did not reduce wheat yields below the check. (Contribu-

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tion from the Research Branch, Experimental Farm, Scott, Saskatchewan, Canada).

"New" herbicides for the control of Canada thistle in barley. Friesen, H. A. Compitox [2-(MCPP)], CP 1815 (mixture of chlorinated benzoic and cresoxyacetic acids), Trysben 200 (2,3,6-trichlorobenzoic acid), and Kloben (50 percent neburon) were tested against various phenoxyacetic and phenoxybutyric formulations to control Canada thistle in barley. Replicated strips were sprayed with a logarithmic sprayer at a starting dosage of 2 lb/A, with the following exceptions: the butyl ester of 4-(2,4-DB) and the sodium salt of 4-(MCPB) were started at 4 lb/A, Kloben at 8 lb/A and Trysben 200 at 1 lb/A. The thistle was mostly of the entire-leaved variety and was 4 to 6 inches tall at the time of spraying. Assessment was by visual scoring and by shoot counts and dry weight of thistles taken at four ½ dosages down each strip. The butyl ester of 2,4-D prevented budding or flowering at ½ lb/A and higher. The butoxyethanol ester of 2,4-D, the butyl ester of MCPA, Diax (isopropylamine salt of 2,4-D) and the phenoxybutyrics at 1 lb/A gave very similar control. The mixed amines of 2,4-D, diethanolamine of 2,4-D, Compitox, Trysben 200 and CP 1815 resulted in markedly less control at rates below ½ lb/A. Trysben 200 starting at 1 lb/A and mixed with the butyl ester of 2,4-D at a constant dosage of ½ lb/A appeared to effect a slightly greater suppression of the thistle than 2,4-D ester. Kloben resulted in no control except at the 8 lb/A rate. Barley injury was evident only from the Trysben—2,4-D mixture at its highest rate. (Contributed by the Experimental Farm, Lacombe, Alberta.)

Herbicides in lieu of tillage of fallow to control Canada thistle. Friesen, H. A. Various herbicides were applied on July 12, 1958 as a substitute for part of the tillage on fallow to control Canada thistle. The plot area had been cultivated in early June to control annual weeds. The thistles were in the bud stage when treated. The herbicides used in 1958 together with the number of thistle shoots, the weight of thistles and yield of barley at harvest time in 1959 are given in the table below.

Herbicide	Barley lb/A	Thistle lb/A	Shoots in 1 sq yd
2,4-D butyl ester 12 + 12 oz/A*	1820	280	4
2,4-D butyl ester 8 + 8 oz/A	2140	85	2
2,4-D butyl ester 2 lb/A	2410	120	7
Amitrol 4 lb/A	2140	43	5
Amitrol 8 lb/A	2390	11	2
Amitrol 6 lb/A	2200	11	1
Check	1570	510	14
D.B. Gran.[1], ¼ lb/100 sq ft	1770	2020	40
D.B. Gran., ½ lb/100 sq ft	760	600	24
D.B. spray, 1 lb/100 sq ft	2240	230	27
Borascu[2], ¼ lb/100 sq ft	440	980	33
Borascu, ½ lb/100 sq ft	2270	760	25
Borascu, 1 lb/100 sq ft	880	1370	25

* 2,4-D at 12 oz/A on July 12 and a further 12 oz/A ten days later.
[1] D.B. Granular, 39.2% B_2O_3, 7.5% 2,4-D.
[2] Borascu, sodium borate ore, 34% B_2O_3.
(Contributed by the Experimental Farm, Lacombe, Alberta.)

Herbicides for the eradication of Canada thistle. McCurdy, E. V. Small replicated plots with a dense cover of Canada thistle were worked in the early part of the season, then the Canada thistle was allowed to grow until it reached the bud stage in July. Herbicides were then applied. Three weeks later half of each plot was rototilled. The more promising rates were used for retreatment in September and all plots will be cultivated just before freeze-up. 4-(MCPB), sodium salt, at 24 and 30 oz/A was not effective in control; regrowth was quite strong at the light rate, but somewhat less at the heavier rate. A butyl ester of 2,4-D at 8 and 16 oz/A resulted in a rapid kill of all topgrowth but later dense regrowth occurred. Amitrol plus ammonium thiocyanate (Amitrol-T) at 3 and 6 lb/A was more effective. Some normal regrowth was noted at the light rate. At the heavier rate much less regrowth appeared and this was quite chlorotic. Amitrol at rates of 4, 6, 8, 10, and 12 lb/A was included in the test. The 4 lb/A rate was not heavy enough, 6 lb/A was more effective but regrowth was quite normal in appearance. At 8 lb/A regrowth was weak and a poor color, and at 10 and 12 lb/A control was excellent. 2,3,6-TBA at 10 lb/A resulted in severe distortion and growth was arrested. After cultivation, some weak regrowth was noted. (Contributed by the Experimental Farm, Indian Head, Saskatchewan.)

Herbicides for the control of Canada thistle. McCurdy, E. V. Herbicides were applied in 1957 and again in 1958 to Canada thistle growing in competition with a brome-alfalfa mixture. In 1959 amitrol at 8 lb/A left the grass about normal and removed most of the Canada thistle; at 12 lb/A a few chlorotic Canada thistle remained but the grass was thinned; and at 16 lb/A the grass was almost removed and was free of Canada thistle and dandelions. 2,3,6-TBA at 8 and 12 lb/A thinned the grass but removed all perennial weeds. Mixed butyl esters of 2,4-D at 16 oz/A reduced the infestation, left the grass normal but thinned the alfalfa. (Contributed by the Experimental Farm, Indian Head, Saskatchewan.)

Herbicides for Canada thistle and sowthistle control, 1959. Selleck, G. W. Mixed butyl esters of 2,4-D, a butoxethanol ester of 2,4-D (ACP L-129) and Amitrol-T (mixture of amitrol and ammonium thiocyanate) were applied with a variable-rate sprayer at initial rates of 8 lb/A in 34 gal of water, to duplicated, 15 x 100 ft plots July 2, 1959. A mixture of butyl ester of 2,4-D at 4 lb/A and Amitrol-T at 4 lb/A initial rates was also applied to Canada thistle. Canada thistle was 8 to 12 in. tall and sowthistle 4 to 6 in. tall on the first date of spraying, and the weeds were 2 to 5 in. tall when they were retreated, Aug. 14. The infestations were tilled once prior to spraying. The rates (lb/A) required to give the designated percentages of control are presented below.

Herbicide	Rate, lb/A, required to give designated percent control					
	Sowthistle			Canada thistle		
	100%	90%	75%	100%	90%	75%
2,4-D butyl ester	1.0	0.5	....	2.9	2.5	1.5
Amitrol-T	1.2	0.5	....	3.9	2.6	1.5
MCPA, butyl ester	0.8	0.6	0.5	3.2	2.0	1.4
2,4-D butoxyethanol	0.8	0.5	....	2.7	1.8	0.9
2,4-D butyl ester, Amitrol-T mixed	....	....	....	3.3	1.8	1.3

Slightly better control was obtained with the butoxyethanol ester of 2,4-D than the mixed butyl esters of 2,4-D. (Contribution No. 269 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agric. Research Foundation.)

LEAFY SPURGE

Several 2,3,6-TBA salts, Fenac, Amitrol-T and 2,4-D acid for the control of leafy spurge. Derscheid, Lyle A. Diethylamine, cesium, lithium, potassium, and rubidium salts of 2,3,6-TBA, the sodium salt of 2,3,6-trichlorophenylacetic acid (Fenac M-673A), and a formulation of 2,4-D acid (Weedone 638) were applied with a logarithmic sprayer at rates of 2 to 8 lb/A and amitrol plus ammonium thiocyanate (Amitrol-T) was applied at rates of 4 to 16 lb/A. All applications were made in 12 gal/A of spray on June 10 when leafy spurge was starting to bloom. Preliminary observations were made August 19. The following treatments appeared to have killed over 95% of the spurge: Ce-TBA 3 to 8 lb/A, Li-TBA 4 to 8 lb/A, Fenac 4 to 8 lb/A, K-TBA 6 to 8 lb/A and Amitrol-T 8 to 16 lb/A. Lower rates of these herbicides and all rates of other herbicides appeared to be ineffective. (Contributed by the Agronomy Department, South Dakota Agr. Exp. St., South Dakota State College, Brookings.

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Granular herbicides on leafy spurge and toadflax, 1959. Selleck, G. W. Borax at rates of 1, 2, and 4 lb/100 sq ft, a BDM (39.2% B_2O_3, 7.5% 2,4-D) at 0.5, 1, and 2 lb, a BMM (41.5% B_2O_3 monuron 4%) at 0.25, 0.5, 1, and 2 lb, and Gerstley Borate (33% B_2O_3) at 2, 4, and 8 lb/100 sq ft, total products, were applied to toadflax near Hague, Sask. and to leafy spurge near Saskatoon, Sask., on sandy-loam soil. The herbicides were applied to 16 x 100 ft plots with a Gandy spreader June, 1956. The mean percentage control Oct., 1959 of weeds and regrowth of grass compared with checks (based on visual estimates) are presented below.

Herbicide	Rate lb/100 sq ft	Percent control Toadflax	Leafy spurge	Percent regrowth grass
BMM	0.25	0	0	25
BMM	0.5	0	25	1
BMM	1.0	90	25	0
BMM	2.0	100	100	0
Gerstley Borate	2.0	100	30	150
Gerstley Borate	4.0	99	90	150
Gerstley Borate	8.0	100	95	95
BDM	0.5	75	70	150
BDM	1.0	95	85	125
BDM	2.0	100	100	150
Borax	1.0	97	95	125
Borax	2.0	99	100	125
Borax	4.0	99	100	75

The regrowth of toadflax which occurred on the borax plots occurred on portions of the plot where competition was lacking, since the grasses had been completely killed out. Western snowberry and *Rosa* sp. were not eradicated at the 2 lb rate of the BMM. (Contribution No. 274 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agric. Research Foundation.)

Herbicides for leafy spurge control in aspen, 1959. Selleck, G. W. A BDM (39.2% B_2O_3, 7.5% 2,4-D) at 1 and 2 lb, borax at 2 and 4 lb, Cal. pellets (13% monuron, 8% 2,4-D), Cal. maintenance (6.9% 2,4-D, 9.4% dalapon, 1.6% monuron) Cal. tad (5% 2,4-D, 7% dalapon) at 0.5 and 1 lb, CC 548 (95% sodium metaborate, 5% MCPA) and CC 520 (93% sodium metaborate, 5% MCPA, 2% monuron) each at 2 lb/100 sq ft, total products, were applied to leafy spurge in aspen in 10 x 10 sq ft plots on sandy loam soil near Saskatoon, April 7, 1958. Two applications of dalapon in each of the years 1958 and 1959 were applied at rates of 10, 20, and 40 lb/A each application. The percentage control of leafy spurge and native grasses are presented in the following table.

Herbicide	Rate, lb/100 sq ft	Percent control Leafy spurge 1958	Leafy spurge 1959	Grass 1958	Grass 1959
BDM	1.0	90	100	0	0
BDM	2.0	95	95	95	100
Borax	2.0	75	100	40	70
Borax	4.0	97	99	90	95
CC520	2.0	99	95	100	99
CC548	2.0	99	100	90	90
Cal. maint.	0.5	50	99	80	99
Cal. maint.	1.0	97	95	90	80
Cal. pellets	0.5	75	90	0	95
Cal. pellets	1.0	90	95	80	99
Cal. tad	0.5	60	95	50	95
Cal. tad	1.0	99	95	99	75
	lb/A				
Dalapon	10	95	75	100	100
Dalapon	20	100	100	100	100
Dalapon	40	99	100	100	100

Aspen appeared to be slightly damaged by dalapon in 1959, but seemed to be unharmed by any of the other treatments. (Contribution No. 278 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agr. Research Foundation.)

Leafy spurge control with 2,4-D, 1959. Selleck, G. W. Several applications of the butyl ester of 2,4-D at an initial rate of 8 lb/A in 34 gal of water were applied with a variable rate sprayer on duplicated, 15 x 135 ft plots to leafy spurge on sandy loam soil near Saskatoon, commencing May 7, 1957. Applications were repeated when regrowth reached a height of 2 to 4 in. The experiment was continued during 1958, using both the butyl ester and the butoxyethanol ester (ACP L-129) of 2,4-D. Further applications were made in 1959 as regrowth warranted it. Plots were assessed Sept. 10, 1959. The rates (lb/A) of repeated applications of 2,4-D necessary for 100% and 95% control are presented in the following table.

No. of treatments 1957	1958	1959	Rate (lb/A) required for 100% control	95% control
2	3	2	1.8	0.3
2	2	0	2.5	1.1
4	4	0	1.4	1.1
4	4	2	1.1	0.2
2	4	2	1.1	0.3
5	4	0	2.5	1.8
6	4	0	5.0	1.6

The degree of control which was provided by the butoxyethanol ester of 2,4-D was somewhat better than that obtained for the butyl ester. (Contribution No. 262 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from Amchem Products Inc.)

Leafy spurge and couchgrass control with amitrol, 1959. Selleck, G. W. Amitrol at an initial rate of 20 lb/A in 34 gal water was applied to leafy spurge and couchgrass on duplicated, 15 x 135 ft plots with a variable-rate sprayer on sandy-loam soil near Saskatoon. The treatments (mowing, spraying and tillage) commenced in May, 1957 and were continued in 1958. Follow-up treatments were not applied for a minimum of three weeks. The number of treatments required to maintain various percentages of control are presented below as a fraction, the numerator representing the rate (lb/A) and the denominator the percent of control, Oct., 1959. M = mowed, S = sprayed, and D = disked.

Treatment 1957	1958	Leafy spurge			Couchgrass		
M, S June 13	2S	13	....	....	6.0	....	5.0
		80			95		75
M, S July 29	1S	5.0	....	....	5.0	4.0	3.0
		100			100	95	75
S July 9	2S	9.0	4.0	3.0	9.0	4.0	5.0
		100	95	75	100	95	75
M, S, D	....	12	....	....	....	....	20
		90					75
M, S, D, S	1S	10	....	....	10	....	....
		95			90		
M, 2S, 2D	1S	5.0	....	....	2.0	1.0	....
		99			99	75	
M, 2S, 2D	3D	7.0	....	....	0	0.5	....
		95			100	90	
M, S, D, S	....	20	....	....	20	....	....
		50			50		
3S, 3D	3D	9.0	5.0	4.0	5.0	4.0	....
		100	95	75	99	75	
S, D, S	2S	4.0	3.0	....	3.5	3.0	....
		100	75		99	75	

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HOARY CRESS

Control of hoary cress with amitrol and Amitrol-T. Bush, D. A. and Krejci, A. E. A solid stand of hoary cress growing on cultivated land was divided into plots of 4 sq rods and treated in the full bloom stage on May 22, 1958. All treatments were applied in 40 gal/A of water. The area was plowed in the fall of 1958 and planted to wheat. Percent of control was determined in July, 1959. Amitrol at rates of 2 and 4 lb/A resulted in 98 and 99% control, respectively. Amitrol-T (amitrol plus ammonium thiocyanate) at 2 and 4 lb/A resulted in 99 and 99% control. Amitrol at 2 lb + PCP at 6 lb/A resulted in 80% control; Amitrol-T at 2 lb + PCP at 6 lb/A gave 75% control. (Contribution from Amchem Products, Inc., and Nebraska State Weed Office).

Herbicides for the control of hoary cress. McCurdy, E. V. Amitrol at 3, 6, and 9 lb/A was applied under very dry conditions to plots of hoary cress on June 3, 1959. In July after much of the top growth had died back the plots were cultivated and notes were taken in September. A marked reduction occurred at the 3 and 6 lb/A rate and almost complete eradication at the 9 lb/A rate. Amitrol plus ammonium thiocyanate (Amitrol-T) at 3 and 6 lb/A was effective and appeared to have given complete control at 6 lb/A. Trysben 200 (2,3,6-trichlorobenzoic acid) at 8, 10, and 12 lb/A was also very slow in action this year but resulted in a marked reduction by fall. Sodium 2,3,6-trichlorobenzoate gave 100% control at 10 and 15 lb/A this year, 2,3,6-TBA under 1958 conditions was not as effective. In 1959, these weeds were distorted and had not made normal growth but were not dead. Fenac (2,3,6-trichlorophenylacetic acid) at 8 and 10 lb/A did not give complete control in 1959. (Contributed by the Experimental Farm, Indian Head, Saskatchewan.)

Herbicides for the eradication of hoary cress growing under crabapple trees. McCurdy, E. V. A dense stand of hoary cress growing under crabapple trees was treated with herbicides in early June when the weed was in flower. Amitrol at 8, 10, and 12 lb/A gave excellent control. Only slight regrowth was noted at the light rate. The trees were not injured. Amitrol plus ammonium thiocyanate (Amitrol-T) at 3 and 6 lb/A was quite effective but slight regrowth was noted in the late fall. The trees were uninjured by this herbicide. 2,3,6-TBA at 10 lb/A did not give complete eradication and some trees showed slight injury. (Contributed by the Experimental Farm, Indian Head, Saskatchewan.)

TOADFLAX

Rotation practices for toadflax control. Forsberg, D. E. For the past six years rotation practices have been compared to determine their potentialities in controlling toadflax. The results of this year's work follow very closely the results of the previous five years. Weed counts taken in the fall of 1959 showed no weeds present in all types of rotations used. However, it must be kept in mind that during the fallow year tillage operations should be thorough and in a three-year rotation summerfallowing should commence in the fall prior to the fallow period. (Contribution from the Research Branch, Experimental Farm, Scott, Saskatchewan.)

Cultural treatments of fallow and stubble for toadflax control. Forsberg, D. E. Six years' data are now available from the fallow treatments and post-harvest tillage treatments for the control of toadflax. Fallow treatments included (1) black or intensively tilled fallow; (2) Fallow that allowed one week of regrowth between operations; (3) black fallow using one-way for initial spring tillage; and (4) black fallow using a plough for initial spring tillage. Post-harvest tillage of stubble included; (1) Ploughing; (2) blade weeding; (3) Cultivating; (4) one-waying; (5) no tillage or check. Weed counts in May, 1959 showed that within patches the number of shoots ranged from 10 to 66 with a mean of 33/sq ft. The patches averaged from 10 to 15 per plot with many scattered shoots. Weed counts after harvest in 1959 revealed that there was no toadflax present in any of the above treatments. The degree of control obtained was equal on both a two- and a three-year rotation. This would indicate that toadflax can be eradicated on field scale infestation by the use of good tillage practices during the fallow period. (Contribution from the Research Branch, Experimental Farm, Scott, Saskatchewan.)

Combination of chemical and cultural treatments for toadflax control. Forsberg, D. E. Concentrated Borascu (sodium borate ore, 61.5% boron trioxide) and a BDM (DB Granular, 39.2% boron trioxide, 7.5% 2,4-D) were applied June 3, 1958 to an area being fallowed at the following rates: the BDM at ¼, ½, 1, 2, and 3 lb/100 sq ft and Concentrated Borascu at ½, 1, 2, and 3 lb/100 sq ft. All the plots were tilled on August 5 with a one-way. By September 18, 1958 there was some regrowth on all plots. In 1959 these plots were sown to a crop of wheat which emerged and soon died out as a result of the treatments applied. Toadflax counts taken in the fall of 1959 showed no plants present and possibly 100 percent kill.

To another area amitrol was applied on July 25, 1958 at 8 lb/A. Ten days later one fifth of the treated area was turned over with a one-way. At weekly intervals thereafter (for 3 weeks) a portion of the area was worked down and one plot was left as the check. Assessment of these plots in the fall of 1959 showed that all plots receiving the tillage operation afforded 100 percent kill of toadflax. On the check plot 17 toadflax plants per sq yd were recorded. The yield of wheat on these plots in 1959 was not affected by the treatments. (Contribution from the Research Branch, Experimental Farm, Scott, Saskatchewan.)

Herbicides for toadflax control, 1959. Selleck, G. W. Low-volatile esters of 2,4,5-T, low-volatile esters of 2,4-D-2,4,5-T, mixed butyl esters of 2,4-D, 2,3,6-TBA, and erbon at initial rates of 20 lb/A and CP 1815 (mixed chlorinated benzoic and cresoxyacetic acids) at an initial rate of 6 lb/A were applied Sept. 8, 1958 with a variable-rate sprayer in 34 gal of water to toadflax on duplicated, 15 x 100 ft plots on silty clay loam soil near Hague, Sask. The plots received 1 or 2 further applications during 1959. The rates (lb/A) required to give the designated percentages of top growth control are presented in the table.

Herbicide	No of sprayings,	Lb/A required to produce the designated percent control			
	1959	100	95	90	75
CP1815	1	....	2.2	1.9	1.6
CP1815	2	2.2	1.3	....	1.0
Erbon	2	8.5	5.0	4.0	3.5
2,4-D esters	1	6.0	6.0	4.0	3.5
2,4-D-2,4,5-T	2	4.0	2.2	0.7	....
2,4,5-T	2	1.0	0.7	....	....
2,3,6-TBA	1	2.0	0.5	....	....

A July retreatment appeared to be slightly more effective than a June retreatment. Erbon provided 100% control of grass at 10 lb/A and 90% control at 8.5 lb/A. TBA provided 100% control of grass at 2.8 lb/A. Grass was not significantly controlled by any of the other herbicides. Top growth control of toadflax was more effective with two applications of TBA than one application of TBA followed by one application of 2,4,5-T. (Contribution No. 270 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agr. Research Foundation.)

Mixtures of herbicides for toadflax control, 1959. Selleck, G. W. Urox [3-(p-chlorophenyl)-1,1-dimethylurea trichloroacetate] at 120 and 200 lb/A, Calmix pellets (13% monuron, 8% 2,4-D) at 217 lb/A and Calmix maintenance (9.4% dalapon, 6.9% 2,4-D, 1.2% monuron) at 217 lb/A were applied in granular form to duplicated, 10 x 10 ft plots, April 14, 1958, on sandy-loam soil near Hague, Sask. The herbicides were applied to toadflax

and mixed stands of bromegrass, crested wheatgrass, and native grasses. Calmix maintenance, Calmix pellets and the heavier rate of Urox, provided 80, 70 and 55% control, respectively, of toadflax in Sept. 1958. The percentage control deteriorated in all plots in 1959. Calmix maintenance controlled grasses completely in both years, while the other plots provided between 60 and 90 percent control. (Contribution No. 271 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agric. Research Foundation.)

Amitrol for toadflax and grass control, 1959. Selleck, G. W. Amitrol at an initial rate of 20 lb/A was applied with a variable-rate sprayer to duplicated, 15 x 100 ft plots in 34 gal/A water June 4, June 24, July 15, Aug. 20, and Sept. 8, on silty clay loam soil near Hague, Sask. The herbicide was applied to toadflax in bromegrass, couchgrass, and native grasses. Some of the plots were retreated in 1959 on May 26, June 19, July 15, Aug. 5 and Aug. 20, with one or two applications, as regrowth of toadflax warranted it. The lb/A required to give the indicated percent control of toadflax and grasses is presented in the following table.

Treatment date, 1958	No. of treatments, 1959	Lb/A required to give Toadflax control, pct.				Grass control, pct.			
		100	95	90	75	100	95	90	75
June 4	1	13.0	6.5	6.0	4.5	....	....	....	....
June 24	2	6.5	0.6	0.5	0.3	13.0	7.0	....	2.0
July 15	2	7.0	0.7	0.5	0.3	....	....	....	....
July 15	1	....	7.0	5.0	3.6	....	....	....	....
Aug. 20	2	1.6	0.8	0.3	....	....	....	0.3	....
Sept. 8	1	1.6	0.3	....	....	....	....	0.3	....
Sept. 8	2	0.7	0.3	....	....	1.6	0.3	....	....

Initial applications of amitrol applied in the fall appeared to provide more effective toadflax control than those applied in spring. Retreatments applied in June appeared to be more effective than those applied in May, and Aug. retreatments appeared to be more effective than those applied in July. Plots which were treated in the fall of 1958 usually did not require a second application until July 1959. In 1958, 100% top growth control was achieved only with the Aug. and Sept. treatments, at a rate of 10 lb/A. (Contribution No. 272 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from Amchem Products Inc.)

Fall vs spring applications of borax for toadflax and leafy spurge control, 1959. Selleck, G. W. Borax at rates ranging from 300 and 1,800 lb/A total product was applied to toadflax and leafy spurge on sandy loam soil near Saskatoon and Hague, respectively, with a 4 ft Gandy spreader on 16 x 100 ft plots in spring and fall, periodically since 1955. The first applications were made in May and September. In 1957 and 1958, applications were made in Oct. and April, as late as possible prior to the fall freeze-up and as early as possible after the spring thaw. Data are provided, where a given rate applied in spring is compared with a lower rate applied in the fall. The percentage control obtained from spring and fall applications (S=spring, F=fall) at various rates is provided in the following table.

Interval after application	Percentage of control from rates (lb/A) of borax indicated: 300 S	300 F	400 S	400 F	600 S	600 F	900 S	900 F	1000 S	1000 F	1700 F	1800 S
					Toadflax							
1st year (1959)	25	95		99	100							
1st year (1958)				100	99							
2nd year (1959)				100	100							
					Leafy spurge							
1st year (1959)			85	100					90	100		
1st year (1958)					65	85		85	75			
2nd year (1959)					100	99		100	100			
1st year (1956)			90	60			99	80			100	99
2nd year (1957)			75	55			95	90			99	99
3rd year (1958)			75	55			95	90			100	95

Although there are some exceptions, borax has provided more consistent control of leafy spurge and toadflax when the herbicide was applied in fall. Data were not included where fall applications were heavier than those applied in the spring. In all of these cases, more effective control was obtained with the fall application. (Contribution No. 266 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agric. Research Foundation.)

Fall vs spring applications of a BDM for toadflax and leafy spurge control, 1959. Selleck, G. W. and R. T. Coupland. Single applications of a BDM (39.2% B_2O_3, 7.5% 2,4-D) at rates ranging from 200 and 1,000 lb/A, total product, were applied to leafy spurge and toadflax on sandy loam soil near Saskatoon and Hague, respectively, with a 4 ft Gandy spreader on 16 x 100 ft plots in spring and fall, periodically since 1955. The first applications were made in May and September. In 1957 and 1958, applications were made in Oct. and April, as late as possible prior to the fall freeze-up and as early as possible after the spring thaw. The percentage control obtained from spring and fall applications (S=spring, F=fall) at various rates is given in the table.

Interval after application	Percent control obtained by indicated rates (lb/A) of a BDM: 200 S	200 F	300 S	300 F	400 S	400 F	500 S	500 F	600 S	600 F	1000 S	1000 F
						Toadflax						
1st year (1958)					99	95			100	100		
2nd year (1959)					100	75			100	100		
1st year (1956)	80	75					98	100			99	100
2nd year (1957)	55	75					90	99			90	100
3rd year (1958)	50	60					85	99			95	100
						Leafy spurge						
1st year (1959)			60	85								
1st year (1958)					95	85						
2nd year (1959)					100	95						
1st year (1956)							99	100			100	100
2nd year (1957)							90	100			99	100
3rd year (1958)							85	99			99	100

Although there are some exceptions, a BDM has provided more consistent control of leafy spurge and toadflax when the herbicide was applied in fall. Data were not included where fall applications were heavier than those applied in spring. In all of these comparisons, more effective control was obtained with the fall application. (Contribution No. 267 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agr. Research Foundation.)

OTHER PERENNIAL WEEDS

Chemical control of climbing milkweed. Anderson, L. E. Foliar applications of various herbicides were made July 8 and 9, 1957, to rapidly growing climbing milkweed plants that were 8 to 10 inches tall. The following herbicides were applied to square-rod plots in three replications: 2,3,6-TBA at 20 and 40 lb/A; PBA at 40 and 60 lb/A; lithium 2,3,6-TBA at 8 and 16 lb/A; potassium 2,3,6-TBA at 8 and 16 lb/A; amitrol at 8 and 16 lb/A; MH at 8 and 16 lb/A; simazin at 12 lb/A; erbon at 80 and 160 lb/A; and 4-(2,4-DB) at 4 and 8 lb/A. The amitrol and MH treatments were followed by plowing two weeks after the applications were made.

Final evaluations were made in October 1959; this concluded observations made over a three-year period. TBA at 20 and 40 lb/A; PBA at 40 and 60 lb/A; erbon at 180 lb/A; simazin at 12 lb/A; and amitrol at 8 lb/A followed by plowing gave up to 95% control of climbing milkweed. The 20 lb rate of TBA appeared to be as effective as the 40 lb rate, but 60 lb/A of PBA gave better control than the 40 lb rate. Simazin at 12 lb/A was more effective at the end of the three-year period than it was after one or two growing seasons. The 160

lb/A application of erbon was highly effective but the 80 lb/A rate did not give satisfactory control. Although amitrol was satisfactory it was less effective than in 1958. (Contribution of the Kansas Agr. Exp. Sta.)

Control of common milkweed with Amitrol-T. Bush, D. A. and Sieck, A. L. Milkweed was treated in a seedling alfalfa field June 13, 1958, when it was in the full bloom stage. The milkweed was 3 feet tall. Amitrol-T (amitrol plus ammonium thiocyanate) was applied as an overall spray at 2 lb/A in 80 gal/A of water. This treatment gave better than 99% control of the milkweed when estimates were made in June, 1959. The seedling alfalfa, which was 6 to 8 inches tall at time of treatment, was also eliminated. Where Amitrol-T was mixed at a rate of 1 and 2 lb in 240 gallons of water and this mixture used to saturate the milkweed plant as a spot treatment, the result were not equal to the 2 lb rate as an overall spray. However, conrol from the spot treatment resulted in 90 and 95% control respectively. (Contribution from Amchem Products, Inc., and Nebraska State Weed Office).

Systemic chemicals on scentless mayweed. Carder, A. C. In the late spring of 1958, the butyl ester of 2,4-D and CP 1815 (mixture of chlorinated benzoic and cresoxyacetic acids) were applied by boom plot sprayer in water at 10 gal/A to an almost solid stand of scentless mayweed, when 3-4 in. high. Appraisals made in 1958 showed that where CP 1815 had been applied at 12 and 16 lb/A most of the top-growth was killed and only the very occasional plant produced flowering stalks, while where 2,4-D had been used at the same rates the mayweed upon recovery flowered profusely and ripened seed. By the early summer of 1959 the non-treated plots and those where 2,4-D had been applied at 8, 12 and 16 lb/A supported 100% stands of mayweed, which later flowered and produced an abundance of seed, while plots treated with CP 1815 showed 4, 2 and 1% stands of the weed for the above rates, respectively. In the solid stands of the check plots 90% of the mayweed plants were overwintered types and 10% new seedlings, while in the 2,4-D series the converse was true. Rate of herbicide application did not affect the relationships. Most of the few plants present in the CP 1815 plots were new seedlings. (Contribution of Experimental Farm, Beaverlodge, Alberta.)

Herbicides for the permanent eradication of patches of scentless mayweed. Carder, A. C. Certain treatments will eradicate scentless mayweed for several months or a full season but re-establishment may take place by viable seed lying in the soil. This test was designed to find a means whereby a patch of mayweed could be eradicated permanently. In the late spring of 1958, Atlacide (58% sodium chlorate) was applied at 1, 2, and 3 lb/sq rod (actual product) to mayweed when 4 in. high. At the same time monuron was applied at 8, 10, and 12 lb/A and amitrol at 6, 8, and 10 lb/A. The herbicides were knapsack-sprayed in water at 80 gal/A. Examinations in 1959 showed that no herbicide gave 100% control. However, the 3 lb/sq rod rate of Atlacide and all rates of monuron reduced regrowth to 1-2%. The 2 lb/sq rod rate of Atlacide was followed by a 15% stand. Where the light rate of Atlacide and all rates of amitrol had been applied almost full stands of mayweed flowered and produced seed. (Contribution of Experimental Farm, Beaverlodge, Alberta.)

The effect of some herbicides on absinthe. Forsberg, D. E. In June of 1958 well established infestations of absinthe were sprayed with amitrol at 2, 4, and 8 lb/A, a BDM (disodium tetraborate, 90.5%, 2,4-D 7.5%) at 1 and 3 lb/100 sq ft and a BMM (disodium tetraborate, 94%, monuron, 4%) at 2 and 4 lb/100 sq ft (products as sold). The 1959 results showed that all rates of BDM and BMM kill the absinthe present in the plots. However, these chemicals also eliminated the grass stands that were present in the test. Amitrol at 2 and 4 lb/A did not control absinthe. At 8 lb/A amitrol resulted in 100 percent kill and had no effect on the stand of grass present in the test. (Contribution from the Research Branch, Experimental Farm, Scott, Saskatchewan, Canada.)

Chemical control of Russian knapweed. McCurdy, E. V. On July 29, 1958, plots of Russian knapweed growing in competition with bromegrass were retreated with 2,3,6-trichlorobenzoic acid. By the fall of 1959 this weed was not completely eradicated with the 5 lb/A application and brome still provided a fair cover. At 10 lb/A control was much more complete but most of the brome was removed. At 15, 20, and 25 lb/A all growth was prevented. A few plants made some regrowth and the grass was recovering following an application of Benzac 354 (polychlorobenzoic acid) at 5 lb/A. Some plants remained a year after treatment when the rate of this herbicide was increased to 10 lb/A. The plots treated with a CBM (Polybor-chlorate, 25% sodium chlorate, 49% boron trioxide) at 3 lb/100 sq ft early in 1958 were free of this weed. Some regrowth has occurred on one of the plots treated with a BDM (DB Granular, 7.5% 2,4-D, 39.2% boron trioxide) at 3 lb/100 sq ft. (Contributed by the Experimental Farm, Indian Head, Saskatchewan).

Herbicides for absinthe control in grass, 1959. Selleck, G. W. The dimethyl amine salt of 2,4-D, low-volatile esters of 2,4,5-T, the butyl esters of 2,4-D, the butyl ester of 2,4-D, the butyl ester of MCPA, and low-volatile esters of 2,4-D-2,4,5-T were applied with a variable-rate sprayer to duplicated, 15 x 135 ft plots at an initial rate of 17 lb/A to absinthe and bromegrass-crested wheatgrass pasture on loam soil near Hepburn, Sask. The herbicides were applied June 21, 1957, when the weed was in the early bud stage. Some of the plots received two applications in 1957 and one in 1958 while the remainder received one application in 1957 and one in 1958. The rates (lb/A) of the herbicides required to produce 100% and 75% kill by June, 1959, are presented below.

	Rate, lb/A, required to give the percent kill indicated			
	Two sprays 1957, one spray 1958		One spray 1957, one spray 1958	
Herbicide	100%	75%	100%	75%
2,4-D ester	1.1	—	1.5	0.9
2,4-D amine	2.4	2.1	2.4	0.9
MCPA ester	1.1	—	2.1	0.9
2,4,5-T	2.4	—	2.1	0.9
2,4-D-2,4,5-T	0.9	—	0.5	—

One application each year appears to be almost as effective as two applications the first year and one the second. Higher rates of herbicides are required for control when the weed is free from competition by other plants. (Contribution No. 268 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agric. Research Foundation.)

Herbicides for absinthe control, 1959. Selleck, G. W. The dimethyl amine salt of 2,4-D mixed low-volatile esters of 2,4,5-T, and 2,3,6-TBA at intial rates of 25 lb/A and amitrol and dalapon at intial rates of 40 lb/A in 34 gal water were applied with a logarithmic sprayer to duplicated, 15 x 135 ft plots May, 1957, on loam soil at Hepburn, Sask. The initial application was made when the plants were 8 in. tall. The area was devoid of grass. Some of the plots received additional applications at similar rates Aug. 8, 1957 and May 23, 1958. The data are presented below as a fraction, the numerator representing the rate (lb/A) and the denominator the resulting percentage of kill, June, 1959.

	Treatment											
	One spray, 1957				Two sprays, 1957							
Herbicide	Absinthe		Dandelion		Absinthe			Dandelion				
TBA	13	10	30	15	4.0	—	—	3.0	—	4.0		
	100	75	100	75	100			100		75		
Amitrol	14	7	14	7	4.0	3.0	2.8	4.0	3.0	2.8		
	100	75	90	75	100	95	75	100	85	75		

XUM

One application of 2,4-D in 1957 followed by another in 1958, controlled dandelion 100% at 3.5 lb/A and 75% at 1.8 lb/A. With one application of 2,4,5-T in 1957 followed by another in 1958, absinthe was controlled 100% at a rate of 6 lb/A and 95% at a rate of 4.5 lb/A. A second application in 1957 did not significantly improve the degree of control in 1959. (Contribution No. 275 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from Amchem Products, Inc.)

The effect of several herbicides applied as soil sterilants on tanweed in western Nebraska. Wicks, Gail A. Several herbicides in 40 gpa spray solution were applied on November 7, 1958 on triplicate square rod plots. The tanweed infestation was located on Hall clay loam. Stem counts were made from permanent square rod plots prior to treatment and on September 5, 1959. The mean square rod count prior to treatment was 34.6 stems. The herbicides used and the percent of control (in parentheses) based on stem counts on three replications were: sodium chlorate at 6 lb/sq rd (100%); granular anhydrous borate ore (Concentrated Borascu, 61.5% boron trioxide) at 12 (91) and 15 lb/sq rd (96); a BDM (DB Granular, 7.5% 2,4-D, 39.2% borontrioxide) at 8 (44) and 10 lb/sq rd (66); 2,3,6-trichlorophenylacetic acid (amide) at 8 lb/A (0); sodium 2,3,6-trichlorophenylacetate at 8 (0), 12 (78), and 16 lb/A (97); 2,3,6-TBA at 16 (8), 32 (92), and 48 lb/A (99%). (Contributed by Univ. of Nebraska Exp. Sta. and Nebraska Department of Agriculture and Inspection, Division of Noxious Weeds, North Platte)

Several herbicides used as soil sterilants on bur ragweed in western Nebraska. Wicks, Gail A. Bur ragweed infestations on Butler silt loam were treated in triplicate with herbicides in 40 gpa spray on November 3, 1958. Three permanent square yard plant counts were taken; at treatment time, and on July 2 and August 10, 1959. The mean count at application time was 50.7 plants to the square yard. Sorghum (RS501) was planted July 2 across ½ of the plots. Sorghum notes were taken July 30, 1959.

Chemical	Rate	Percent control		Pct. sorghum survival and injury
		July 2	Aug. 10	
Sodium chlorate	6 lb/sq rd	100	100	15*
	lb/A			
Fenac[1] (Na salt)	4	93	73	100
	8	96	91	15‡
	12	100	99	8‡
Fenac (amide)	4	71	39	88†
	8	97	95	65§
	12	98	93	63§
2,3,6-TBA	4	61	48	100
	8	86	78	100†
	12	95	92	95‡
	16	100	99	90§
	20	98	99	68§

[1]2,3,6-trichlorophenylacetic acid
*Yellow and stunted
†Occasional curled leaf
‡Curled leaves
§Curled leaves, lodged plants, severe brace root injury and drought stress

(Contributed by Univ. of Nebraska Exp. Sta. and Nebraska Department of Agriculture and Inspection, Division of Noxious Weeds, North Platte.

Effect of tillage on the toxicity of herbicides to bindweed. Wiese, A. F. and Rea, H. E. PBA (30% trichloro) at 10 and 5, amitrol at 5 and MH at 5 lb/A, respectively, were applied to vigorously growing bindweed on June 7, 1957. Plots of each rate of the herbicides were left alone, sweep plowed in 1½ weeks, or sweep plowed in 3 weeks after treatment. It was observed that a single tillage operation did not increase the toxicity of the herbicides. As a result, the plots plowed 1½ weeks after application were plowed 2 more times during the season. Data taken on June 5, 1958 showed that 10 and 5 lb/A of PBA controlled 64 and 13% of the weeds. Three extra tillage operations increased the control for the 2 rates of PBA to 96 and 85%. Amitrol and MH treatments did not appreciably reduce the bindweed. Cultivation at 3-week intervals during the summer reduced the bindweed 69%, and an ester formulation of 2,4-D applied at ⅓ pound per acre at monthly intervals gave 97% control. (Contribution from the Southwestern Great Plains Field Station, Bushland, Texas. Texas Agr. Exp. Sta. and USDA, cooperating. Approved as TAES T.A. 3354.)

Bindweed control with benzoic and phenylacetic acid formulations. Wiese, A. F. and Rea, H. E. During April, 1958 various formulations and derivatives of benzoic and phenylacetic acids were applied to square rod plots of bindweed growing on dryland Pullman silty clay loam soil. Split-plot experiments with 3 replications were conducted at 2 locations. The sub-plots were the herbicides and the main plots were 5, 10 and 20 lb/A rates of application. The average percent control by July, 1959 from the 3 rates of application at the 2 locations was: Amine salt of TBA 75, amine salt of PBA (30% trichloro) 66, amine salt of PBA (80% trichloro) 71, amine salt of PBA (2% trichloro) 58, butylcellosolve ester of PBA (30% trichloro) 63, sodium 2,3,6-trichlorophenylacetate 86, and butylcellosolve ester of 2,3,6-trichlorophenylacetic acid 84. Sodium chlorate applied at 400, 800, and 1000 pounds per acre gave an average of 83% control. The LSD at the 5% level was 12%. (Contribution from the Southwestern Great Plains Field Station, Bushland, Texas. Texas Agr. Exp. Sta. and USDA, cooperating. Approved as TAES T.A. 3355.)

ANNUAL, WINTER ANNUAL, AND BIENNIAL WEEDS

WILD OATS

Carbyne [4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate] as a post-emergence treatment for control of wild oats. Brown, D. A. This test was located on third crop stubble land known to be very heavily infested with wild oats. Wheat was seeded early in May before many wild oats could be killed by preseeding tillage. The herbicide was applied at four rates in two volumes of water at two stages of plant development.

Stage of wild oats	Carbyne lb/A	Volume per acre, gal	Wild oats culms in crop prior to harvest No. sq/ft	Yield per acre	
				Clean wheat, bu	Wild oats cleaned from wheat bu
1 to 2 leaf	0	0	48	9.8	4.2
	.75	5	34	12.9	4.2
	1.0	5	29	10.6	3.6
	1.5	5	40	8.2	3.6
1 to 2 leaf	0	30	63	8.9	2.9
	.75	30	30	11.5	3.2
	1.0	30	49	8.4	2.8
	1.5	30	25	11.9	2.7
2 to 3 leaf	0	5	39	11.1	4.8
	.75	5	47	9.3	4.5
	1.0	5	69	8.8	4.6
	1.5	5	42	12.5	4.4
2 to 3 leaf	0	30	66	9.3	2.8
	.75	30	60	9.3	5.2
	1.0	30	55	9.9	5.1
	1.5	30	35	8.5	5.3

Average number of culms per sq/ft: early stage 39; late stage 52. Culms per sq/ft summary all rates of application 0, 54; 0.75 lb, 43; 1 lb, 50; 1.5 lb, 36. Water volume, average all treatments, low volume 44 culms per sq/ft, high volume 48. (Experimental Research Farm, Brandon, Manitoba.)

Pre-planting application of 2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture (CP 15336, or Avadex) and EPTC (Eptam) for control of wild oats and green foxtail. Brown, D. A. Wheat, flax and sunflowers were the crops grown, seeded within one week after treatments were applied. Applications in water at 15 gal/A were made to a soil surface known to be heavily infested with wild oats and green foxtail. The herbicides were immediately worked into the soil by rototilling.

	Wheat			Flax			Sunflowers		
	Weed control			Weed control			Weed control		
Treatment lb/A	Wild oats %	Green foxtail %	Yield bu/A	Wild oats %	Green foxtail %	Yield bu/A	Wild oats %	Green foxtail %	Yield bu/A
Avadex									
2	71	92	21.0	70	51	17.3	85	65	4.0
4	78	94	15.1	91	69	16.4	100	76	4.0
6	98	99	7.0	98	86	13.9	100	89	4.0
Eptam									
2	85	54	22.2	60	81	16.6	53	83	3.6
4	99	75	7.8	80	98	13.6	81	90	3.9
6	98	68	1.3	78	98	13.6	96	100	3.6
Check	0	0	40.7	0	0	10.3	0	0	3.9

Wheat failed to establish normal stands following any of the treatments. Flax produced normal stands on all plots treated at the lower rates and even on thinned stands caused by the heavier rates the yields were significantly higher than the check, due almost entirely to the extreme competition afforded the flax by wild oats and green foxtail on untreated plots. Weed control in sunflowers was excellent with the crop showing no effect from the treatments. (Experimental Research Farm, Brandon, Manitoba.)

EPTC (Eptam) and 2,3-dichloroallyl diisopropylthiolcarbamate (Avadex) for wild oat control in flax. Carder, A. C. On May 11, 1959, an area of good soil which was in summerfallow the previous year and heavily contaminated with a natural infestation of wild oats was lightly harrowed, sprayed, and the herbicides immediately incorporated by double-discing. Spraying was done on triplicate plots by boom plot sprayer delivering 10 gal/A. Weather was calm, warm, and bright. The following day the area was seeded to Redwing flax. Satisfactory soil moisture induced good crop establishment. Rates of herbicides used and results are described in the table.

Herbicide	Lb/A	Yield wild oats lb/A	Yield flax bu/A	Decrease of wild oats, pct	Increase in yield of flax, pct.
Eptam	Nil	342.1	9.3		
	2	85.7	14.0	75	51
	4	16.8	13.9	95	49
	6	23.7	14.1	93	52
Avadex	2	2.1	15.2	99.4	63
	4	2.1	16.1	99.4	73
	6	1.4	15.4	99.6	66

The data show that all rates of Eptam increased the yield of flax by about 50%. However, the two heavier rates caused temporary injury to the crop which apparently had fully recovered by harvest. Only these same rates gave a high degree of wild oat control. All rates of Avadex gave over 99% control of wild oats and increased yields of flax by about ⅔. The heaviest rate of Avadex caused temporary injury to the flax. (Contribution of Experimental Farm, Beaverlodge, Alberta.)

The residual effect of EPTC (Eptam) and 1,2,4,5-tetrachlorobenzene on wild oats and cultivated crops. Carder, A. C. During 1958 Eptam at nil, 5, and 10 lb/A and 1,2,4,5-tetrachlorobenzene (M-1294) at nil, 10, and 20 lb/A were applied early in the spring and again in the autumn to a field of good agricultural soil heavily polluted with a natural infestation of wild oats. The herbicides were applied in granular form and immediately incorporated under ideal conditions by double discing, the second working crosswise to the first. Certain of the plots treated with Eptam in the spring were at once sown to flax and the remainder to barley 3 weeks later. In the early spring of 1959, flax and barley were sown over all plots. In 1958, Eptam at rates used gave complete control of wild oats, but destroyed all barley, at 5 lb/A slightly injured the flax, and at 10 lb/A caused severe injury to flax. 1959: 1. Where Eptam had been applied the previous spring at 5 lb/A very few wild oats grew, and where applied at 10 lb/A no wild oats grew. These reductions in wild oats compared to the check plots, which were heavily infested, are in part due to the fact that wild oats were prevented from growing on the treated plots in 1958. 2. The above treatments had no effect on the growth of flax, but reduced the vigour of the barley, particularly at the 10 lb/A rate. 3. Eptam applied in the fall of the previous year prevented all growth of wild oats but both rates injured flax and barley. 4. Tetrachlorobenzene proved less toxic to wild oats than Eptam but produced a similar degree of injury to the cultivated crops. (Contribution of Experimental Farm, Beaverlodge, Alberta.)

Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) for wild oat control in spring wheat. Carder, A. C. On May 6, 1959, an area of good soil, which was in summerfallow the previous year and heavily contaminated with a natural infestation of wild oats, was harrowed and sown to Saunders wheat. Soil moisture was good and the crop established itself promptly and well. The herbicide was applied to triplicate plots by boom plot sprayer. The first application was made on May 26, the second on June 4. Procedure details and results are given in the table.

Time of application	Water gal/A	Rate oz/A	Yield wild oats lb/A	Yield wheat bu/A	Pct. increase or decrease of wild oats	Pct. increase or decrease of wheat
Wild oats	5	Nil	268	25.6		
1½ leaf stage		4	80	28.5	—70	+11
		8	57	32.2	—79	+26
		16	19	32.4	—93	+27
	30	Nil	201	25.6		
		4	52	32.7	—74	+28
		8	41	30.9	—80	+21
		16	35	25.8	—83	+ 1
Wild oats	5	Nil	106	28.1		
3 leaf stage		4	121	27.8	+15	— 1
		8	78	27.4	—26	— 2
		16	41	27.7	—62	— 1
	30	Nil	184	23.8		
		4	57	29.4	—69	+24
		8	20	26.4	—89	+11
		16	9	18.4	—95	—23

Because of lack of uniformity of the natural weed infestation and insufficiency of replication the data are not conclusive. However, the following inferences seem warranted: 1) that best selectivity was obtained by applying Carbyne when the wild oats were at the 1½ leaf stage, 2) that when applied thus a considerable degree of wild oat control was obtained and that increasing the rate gave increased control, and 3) that also when applied thus a higher degree of selectivity was obtained with the heavier dosages when the low gallonage of water was used. The effect of Carbyne on the wild oats seemed to be one of stunting rather than killing. (Contribution of Experimental Farm, Beaverlodge, Alberta.)

Effects of soil treatments of Niagara 5996 (2,6-dichlorobenzonitrile) on seeded wild oats in the field. Corns, Wm. G. Duplicate plots were sprayed with the above compound immediately prior to double disking of the treated areas on May 20, 1959. The rates were 0, 1, 2, 3 lb/A Nia. 5996 in 30 gal/A water. Wild oats at 2½ bu/A were sown in 6" spaced rows immediately after

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disking. Soil was moist to the surface. The table summarizes the results as percent of check.

	Results as percent of check Nia. 5996, lb/A		
	1	2	3
Plants June 11	75	60	57
Tillers Aug. 12	108	77	84
Dry weight Aug. 12	107	87	89

As used here, this herbicide appears to be unsatisfactory for the purpose. (Division of Crop Ecology, Dept. of Plant Science, Univ. of Alberta).

The effect of EPTC and Avadex or CP 15336 when used as a pre-emergence spray on wild oats in wheat. Forsberg, D. E. In the spring of 1959 a replicated, randomized block design was laid out on an area infested with wild oats and sprayed with EPTC and Avadex or CP 15336 (2,3-dichloroallyl diisopropylthiolcarbamate cis and trans mixture) before seeding. Each of these herbicides was applied at 2, 4, and 6 lb/A in 30 gal/A water, and disced into the soil immediately after application with a double disc harrow. One week later Thatcher wheat was sown on the treated area. Results are presented in the following table:

Treatment	Wheat yield bu/A	Wild oats per sq yd	Wt/bu wheat, lb	1000 kernel weight, grams
Avadex 2 lb/A	21.4	4	61.6	31.5
Avadex 4 lb/A	20.2	2	62.5	32.6
Avadex 6 lb/A	23.9	2	62.0	31.6
Eptam 2 lb/A	19.3	13	62.0	31.9
Eptam 4 lb/A	18.1	35	62 2	31.3
Eptam 6 lb/A	17.5	4	61.1	31.3
Check	18.8	46	61.7	31.8
L.S.D. 5% level	nil			

All rates of Avadex gave very good control of wild oats while with Eptam only the 6 lb rate resulted in any substantial degree of control. (Contribution from the Research Branch, Experimental Farm, Scott, Saskatchewan.)

The effect of Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) on wild oats and grain. Forsberg, D. E. In 1959 Carbyne was sprayed on wild oats in a crop of wheat at the 1 to 1.5 leaf stage and at the 2 to 3 leaf stage of the oats, at ¼, ½ and 1 lb/A, each rate in 5 and 30 gal/A water. Conditions throughout the growing season were good. General observations throughout the growing season would indicate that Carbyne caused a delayed maturity of wild oats rather than a complete kill. None of the treatments caused a complete kill of wild oats. However, reductions in height, tiller counts, plant counts and dry weight per acre were obtained with 1 lb/A in 5 gal/A of water at either date applied. Similar results were obtained with the ½ lb/A rate in 5 gal/A water at the 1 to 1.5 leaf stage of wild oats. (Contribution from the Research Branch, Experimental Farm, Scott, Saskatchewan.)

Avadex, EPTC and CP 5996 as pre-planting treatments for the control of wild oats. Friesen, H. A. Trial I —On April 21, 1959 Avadex (2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture) and EPTC (Eptam) were sprayed at 2, 4, and 6 lb/A in 5 gal/A of water on loam soil very heavily infested with wild oats. CP 5996, 2,6-dichlorobenzonitrile, at 1 and 2 lb/A was also included in this trial. Directly after spraying, one-half of each plot was double-disced while the remainder of each plot was double-disced twice. Part of each plot was seeded to Vantage barley on April 28th, then on May 13th bands of Vantage barley and Redwing flax were seeded on the remaining portions. Trial II—on May 12 the same treatments were laid down on a sandy loam soil which was heavily infested with wild oats. Seeding of barley and flax was done at only one date, May 19. Trial III—Eptam at 2 and 4 lb/A, Avadex at 2, 3, 4, and 6 lb/A and Avadex (granular) at 2, 4, and 6 lb/A were applied on light loam soil on May 25. One-half of each strip was one-way disced once while the other one-half was one-way disced twice directly after treatment. Olli barley was seeded on May 29th.

Trial I—The wild oats population on the untreated plots averaged 1000 plants per square yard. Avadex at 2 and 4 lb/A reduced the number of wild oats by 80% and at 6 lb/A by 90%. Barley plants were reduced in number by nearly 50% by the 4 and 6 lb/A Avadex treatments. Eptam at 4 and 6 lb/A reduced the number of wild oats by 85% and of barley plants by 50%. Eptam at 2 lb/A gave only 20% reduction in the number of wild oats. Due to the extremely heavy wild oats infestation the barley and flax yields on the untreated plots were near failures. Avadex at all rates and Eptam at 4 and 6 lb/A gave highly significant yield increases of both barley and flax. Eptam at 2 lb/A did not significantly increase the yields of these crops. CP 5996 had no effect on either the wild oats or grain. Soil conditions were extremely cold at the time of spraying—seven inches of snow fell on the day following treatment. Crop residue at spraying time was heavy.

Trial II—the wild oat control and yields of crop followed similar trends to those described in Trial I. However, the soil was much lighter in texture, warmer and nearly free of crop residue. These factors may account for the accelerated activity of the herbicides. Avadex at all rates reduced the number of wild oats by 90-95%, but the number of barley plants was reduced only by the 6 lb/A rate. Eptam at all rates reduced the number of wild oats by 75-80%; at the two heaviest rates the numbers of barley and flax plants were significantly reduced. Again, due to severe competition, these treatments, except 6 lb/A, significantly increased the yields of both crops. The number of green foxtail plants in these plots was reduced 40-45% by Avadex. Flax showed greater tolerance to both herbicides than did barley.

Trial III—Under the nearly wild-oats-free conditions of this trial, Avadex in both the liquid and granular forms significantly reduced the number of barley plants and the yield of grain when used at 4 and 6 lb/A. This was also true of Eptam at 4 lb/A. Avadex at 2 and 3 lb/A did not reduce the barley yield but at the heavier rate there was some reduction in the number of barley plants. Incorporation method had no measurable effect in any of these trials. (Contributed by the Experimental Farm, Lacombe, Alta.)

Effect of different dates of fall tillage on the number of wild oats in a crop of barley. McCurdy, E. V. In a group of plots sown continuously to barley, different dates of spring and fall cultivation were compared. The dates of cultivation, with the wild oat plants/sq yd given in parentheses, were as follows: Sept. 20, (0.5); Oct. 5, (0.8); Oct. 25, (1.5); Oct. 25 and early spring, (7.8); no tillage until just before seeding, (11.0). Under 1959 conditions the wild oat count increased as the cultural operations were delayed. On the basis of four years' data, fewer wild oats occurred in the crops that were worked in late September and early October than at the other dates used in this project. (Contributed by the Experimental Farm, Indian Head, Saskatchewan.)

Preplanting herbicides for wild oat control. McCurdy, E. V. EPTC and Avadex (2,3-dichloroallyl diisopropylthiolcarbamate) at 2, 4, and 6 lb/A were applied to plots with a uniform infestation of wild oats. The herbicides were worked into the soil on one-half the plots with the rototiller and into the other half with the disk. Three days later strips of wheat and flax were sown across the plots. Wild oat plants were counted the last week in August. Very little difference was noted between the two methods of incorporation, but with both herbicides progressive decreases in the number of wild oats occurred with the increased rates of application. The wild oat count per sq yd with EPTC at 2 lb/A was 19; at 4 lb/A, 7 and at 6 lb/A, 2; with Avadex at 2 lb/A, 9; at 4 lb/A, 6, and at 6 lb/A, 4. The average of the 8 checks in this project was 93. Only visual estimates of crop damage could be made. EPTC injured wheat at

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all rates, completely killing the wheat at 6 lb/A. Flax was not injured at the light rates but some injury was noted at 6 lb/A. With Avadex at 2 lb/A wheat was almost normal, some injury was evident at 4 lb/A and injury was severe at 6 lb/A. Flax appeared quite normal until the 6 lb rate was reached. (Contributed by the Experimental Farm, Indian Head, Saskatchewan.)

Preplanting herbicide for wild oat control. McCurdy, E. V. Niagara 5996 (2,6-dichlorobenzonitrile) at ½ and 1 lb/A was applied to the soil of a field with a heavy population of wild oats. The herbicide was thoroughly incorporated with a tandem disc immediately following application. Flax and wheat were sown across all plots four days later. Square yard plant counts indicate a marked reduction in the number of wild oats. The check averaged 231, ½ lb/A 170, and 1 lb/A 126. This was not control. The wild oats that germinated grew normally and there was little difference in height at maturity. Yields of wheat were slightly lower in the treated plots at both rates. (Contributed by the Experimental Farm, Indian Head, Saskatchewan.)

Chemical control of wild oats. McCurdy, E. V. 4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate (Carbyne, S-847) was applied to a group of plots severely infested with wild oats. Rates of application were 4, 8, and 16 oz/A in 10 and 30 gallons of water, at two stages of growth, 1½- to 2-leaf stage and 2- to 3-leaf stage. Bands of wheat and flax had been sown across these plots but because of drought conditions and some cutworm damage the crops were very thin and offered negligible competition to wild oats. Square yard plant counts were taken in August. The checks averaged 99 wild oats/sq yd; the 4 oz/A application, 88; the 8 oz/A, 68; and the 16 oz/A, 64. Growth of the wild oats was definitely suppressed in the early part of the season but later these plants came ahead and produced a fair amount of seed. Little difference in the height of wild oat plants was noted at maturity. Average height of the wheat was 22.5 inches for the check; 23.6 for the 4 oz/A rate; 23.3 for 8 oz/A; and 21.3 for 16 oz/A. Some injury was evident at 16 oz/A. Yields were not lowered but this could be accounted for by the lack of wild oat competition in the early part of the season. (Contributed by the Experimental Farm, Indian Head, Saskatchewan.)

Fall application of EPTC for wild oat control, 1959. Selleck, G. W. EPTC was applied Oct. 28, 1958 to a natural infestation of wild oats on stubble on silty clay loam soil near Saskatoon. The herbicide was applied with a logarithmic sprayer at rates between 8 and 0.1 lb/A in 34 gal of water to duplicated, 15 x 135 ft plots, and was incorporated in half of them with a double disk immediately after application. Plots were seeded to Montcalm barley, Selkirk wheat, Norland flax, Argentine rape, and Fortune oats, April 30, 1950. The 1959 growing season was very dry so that crops were thin and short. Weed and crop reduction data are presented in the following table as a fraction, the numerator representing the rate of application (lb/A) needed to achieve the percentage of control in the denominator.

Treatment	Wild oats	Barley	Flax	Rapeseed	Oats	Wheat
Not disked	4.9 3.5 2.0	8.0	8.0	8.0	3.5 2.9 1.6	8.0
	95 90 75	0	0	0	95 90 75	0
Disked	2.0 1.1	3.8 2.3	3.7	1.8 0.8	2.3 1.3	3.3 1.7
	100 95	95 90	98	95 90	98 95	98 95
	0.8 0.2	1.9	1.2	0.2	0.5 0.3	1.0 0.5
	90 75	75	90	75	90 75	90 75

The killing effect on both crops and weeds was improved by incorporation of the herbicide into the soil. (Contribution No. 257 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agric. Research Foundation.)

Various herbicides for wild oat control, 1959. Selleck, G. W. Pre-seeding applications of various herbicides were applied May 13 with a variable-rate sprayer to a natural infestation of wild oats on loam soil near Spalding, Sask. Granular 2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture (Avadex or CP 15336) was applied at rates of 6, 3, and 1.5 lb/A with a Gandy spreader. Solventless Avadex and 2,6-dichlorobenzonitrile (N5996) were applied at rates ranging from 6 lb/A to 0.4 lb/A, and *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron or M1329) was applied at an initial rate of 16 lb/A. N5996 and M1329 were applied in 34 gal/A of water while solventless Avadex was applied in 16 gal/A of water. The herbicides were applied on quadruplicated, 15 x 200 ft plots, half of which were disked once and the other half disked twice immediately after spraying. Montcalm barley and Thatcher wheat were seeded the following day. The rates re quired for control (reduction in stand) of wild oats and crop plants are listed below as fractions, with the numerator representing the rate (lb/A) and the denominator the resulting percentage control.

	Wild oats		Barley		Wheat	
Herbicide	One disking	Two diskings	One disking	Two diskings	One disking	Two diskings
Granular		6.0 3.0 1.5		6.0 3.0 1.5		
		95 95 65		65 25 10		
Avadex Solventless	2.6 1.0 0.7	1.3 0.6 0.4	4.1	6.0		
	98 95 65	99 95 75	35	0		
Avadex N5996	1.6 1.0	3.3 2.2 1.0 0.6			2.2 1.6	3.5 2.8 1.7
	95 75	100 95 90 75			90 75	98 95 45
Zytron	16.0	16.0			16.0	16.0
	0	0			0	0

On stubble land, two incorporations of the herbicide appeared to be more effective for wild oat control than one. Accumulations of straw in swaths which prevented incorporation of the herbicide into the soil resulted in poor wild oat control and poor crop germination. (Contribution No. 254 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Monsanto Chemical Company.)

Pre-planting herbicide treatments for the control of wild oats, green foxtail, and broad-leaf annuals in a variety of crops. Sexsmith, J. J. The following materials at rates specified were applied to the surface of a silty clay loam irrigated soil at Lethbridge, Alberta, on June 3, immediately disked in two directions with a double disk to a depth of 2 to 3 inches, and duplicate plots seeded to 13 crops: EPTC liquid at 3 lb; and EPTC granular at 2 and 3 lb/A; 2,6-dichlorobenzonitrile (Niag. 5996) at 1 and 2 lb/A; 2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture (Avadex), at 2 and 4 lb/A; IPC at 4 and 6 lb/A; and endothal at 6 and 8 lb/A. All but the EPTC granular were applied as sprays at 34.3 gpa. The infestation of wild oats was increased by a broadcast seeding on June 1, and the light infestation of broad-leaf annuals was a mixture of redroot pigweed and lambsquarters. Visual estimates of weed control and crop injury ratings were made on July 27. Excellent control of wild oats and green foxtail, and some control of broad-leaf weeds, was obtained with 2 lb of EPTC granular and 3 lb of EPTC liquid with no injury to potatoes, very slight injury to beets, peas, beans, and corn, some injury to carrots and flax, and serious injury to cucumbers, mustard, barley, and wheat. The 1-lb rate of Niag. 5996 gave fair to good control of wild oats and broad-leaf annuals without more than moderate injury to peas, beans, flax, and corn. Avadex at 2 lb/A gave very good control of wild oats and fair control of green foxtail as compared with IPC at 4 lb, which gave equal control of wild oats but none for foxtail. The 2-lb rate of Avadex caused no injury to potatoes, beets, peas, beans, and corn, and only slight injury to cucumbers, carrots, mustard, and flax. Endothal gave poor weed control even at the 8-lb rate. (Canada Agriculture, Research Station, Lethbridge, Alberta.)

Effect of Carbyne on wild oats and spring wheat. Sexsmith, J. J. A factorial test was set out in 1959 at Lethbridge to determine the effects of 4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate (Carbyne) used for selective control of wild oats in spring wheat at two growth stages (1st, wild oats 1- to 1½-leaf stage; 2nd,

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wild oats 2- to 3-leaf stage), two spray volumes (8.1 and 34.3 gpa), and at rates of 0, ¼, ½, and 1 lb/A. Thatcher wheat was seeded on May 29 into a dry-land silty clay loam, continuously cropped to spring wheat since 1911 and having a reasonably heavy infestation of wild oats as well as of green foxtail, determined by counts taken on July 24 to be 204 wild oat and 810 green foxtail plants per sq yd. Heights of 10 wild oat and 10 wheat plants were taken in each plot of two of the four replicates at weekly intervals from date of 1st treatment through to time of wild oat heading, a period of six weeks. Estimates of wild oat stands were taken at harvest time, and eight rod-length rows were harvested from each plot for yield determinations. Yields are not yet available. Green foxtail apparently was unaffected by any of the treatments. Based on the heights, actual wild oat killing was greater from 1st date treatments and from low volume applications. Wild oat height at heading time (July 23) of the living plants decreased with increasing application rate and in general was less for the low volume applications. Only slight effect on wheat height was recorded, with some height reduction from the higher rates of the 2nd date applications. As estimated at harvest time from the headed-out wild oat plants, the 1st date treatments (wild oats 1- to 1½-leaf) were superior to 2nd date treatments; at all but the 1-lb rate, low volume applications were superior to high volume applications; and ½ lb at 8.1 gpa was practically equal to 1 lb at 34.3 gpa, giving slightly less than 80% wild oat stand reduction. (Canada Agriculture, Research Station, Lethbridge, Alberta.)

Effect of nitrate fertilizer on wild oat stand and seed vitality. Sexsmith, J. J., and Pittman, U. J. Ammonium nitrate (33.5-0-0) was broadcast at 110 lb/A on two stubble strips of a dark brown silty clay loam at Magrath, Alberta, on April 22, 1959, with unfertilized areas left in each strip. The fertilizer application was followed by snow, and the whole area was cultivated on April 30 and again cultivated and harrowed before seeding oats on May 15. Wild oat stand counts were taken on June 5, using a 5-in. x 3-ft frame placed between crop drill rows at a total of 40 paired locations in the two strips. On this same date and in the same locations 6 x 8 x 4-in. soil samples were obtained and bulked, and the wild oat seed was separated from soil after drying. The seed was picked over, discarding all kernels that obviously had sprouted prior to sampling. Germination tests were made on 400-seed lots from both fertilized and unfertilized areas on July 6, the remnants later de-hulled, pricked, and germinated on September 30. Wild oat infestation in the broadcast-fertilized areas was 5⅓ times greater than in the unfertilized areas, being 1612 compared with 304 plants/sq yd. No yield sampling was conducted, but the farm operator claimed a 25-bu/A yield of oats from the fertilized areas, the crop on unfertilized areas being too poor to harvest. This would indicate that a wild oat infestation of 304 plants/sq yd was sufficient to destroy an unfertilized oat crop, whereas inter-weed competition plus competition afforded by the fertilized oat crop was sufficient to combat an infestation of 1612 wild oats/sq yd. Germination of seed samples taken from the soil showed an equal but low percentage of non-dormant seeds from both fertilized and unfertilized areas. However, total viability of the full hulls was 97.1% from unfertilized and 88.7% from fertilized areas, which might indicate a devitalization of 8.4% of the seed by ammonium nitrate. Increased infestation in the fertilized areas may have been the result of a chemical breaking of seed dormancy such as may occur in laboratory germination of seed samples when increased germination results if seed is soaked in KNO_3 solution. (Canada Agriculture, Research Station, Lethbridge, Alberta.)

Pre-planting treatments with three triazines for the control of wild oats, green foxtail, and broad-leaf annuals in a variety of crops. Sexsmith, J. J. Three triazines—simazin and 2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine (Atrazine) at 1 and 2 lb/A, and 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine (Trietazine) at 2 and 4 lb/A—were applied to the surface of a silty clay loam irrigated soil at Lethbridge, Alberta, on June 3, and immediately disked in two directions with a double disk to a depth of 2 to 3 inches. Duplicate plots were seeded to 13 crops. All materials were applied as sprays at 34.3 gpa. The infestation of wild oats was increased by a broadcast seeding on June 1, and the light infestation of broadleaf annuals was a mixture of redroot pigweed and lambsquarters. Visual estimates of weed control and crop injury ratings were made on July 27. The 1-lb rates of simazin and Atrazine gave excellent control of wild oats and broadleaf annuals, but only fair control of green foxtail. Both materials caused severe injury to or killed all crops but corn, which was not affected. The 2-lb rate of Trietazine gave good control of wild oats and fair control of green foxtail and broadleaf annuals while causing no injury to corn and only slight injury to potatoes and peas. (Canada Agriculture, Research Station, Lethbridge, Alberta.)

4 - chloro - 2 - butynyl *N* - (3-chlorophenyl)carbamate (Carbyne, S-847) applied post-emergence for the control of wild oats in wheat and flax in 1959. Wallace, Wilford H., and Derscheid, Lyle A. Thirty treatments were applied in a split-plot design to quadruplicate 1x3-rod plots of wheat at rates of 0, ⅛, ¼, ½, and 1 lb/A, in 12½ and 25 gal/A of spray at 3 dates (May 9, 12, and 15) when wild oats was in 2-, 2½-, and 3-leaf stages and wheat was in 2½-, 3-, and 3½-leaf stages, respectively. Similar treatments were applied in triplicate to flax when the wild oats were in 3-, 4-, and 5-leaf stages and the flax was 2, 4, and 6 in. tall (June 5, 8, and 11).

Wild oats counts on June 24 in the wheat and on July 8 in the flax showed reductions of 59, 61, 79, and 83% in wheat and 61, 62, 55, and 56% in flax, respectively, for ⅛, ¼, ½, and 1 lb/A rates of application of Carbyne. The yields for the same rates of application, as percent of check, were 115, 120, 118, and 113% respectively, for wheat, and 109, 112, 86, and 81% for flax.

Statistical analyses did not reveal any significant differences in stand of wild oats or yield of crop among whole-plots (volumes of carrier) or among sub-plots (dates of application). However, comparatively large differences would be required to give a statistically significant difference. Some differences did exist among the sub-sub-plots (rates of application). All treatments reduced the stand of wild oats significantly in both experiments. The higher rates (½ and 1 lb) reduced it significantly more than the lower rates in the wheat experiment. The yield of wheat was significantly higher on treated plots than on untreated plots, but there was no difference among treatments, while the yield of flax was significantly lower on plots treated with the 2 higher rates than on plots treated with the 2 lower rates. Both experiments were conducted under conditions of extreme drouth, which may have affected the results. (Contributed by the Agronomy Department, South Dakota Agr. Exp. Sta., South Dakota State College, Brookings.)

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TCA applied to crops of oats and barley for control of green foxtail. Brown, D. A. The herbicide was applied at rates of 1.5 and 3 lb/A, in water at 12 gal/A, when grain plants were in four-leaf stage and green foxtail in early seedling stage.

Treatment	Oats		Barley	
TCA	Control green foxtail	Yield per acre	Control green foxtail	Yield per acre
	%	Bu.	%	Bu.
1.5 lb/A	58	61.9	54	62.9
3.0 lb/A	72	63.6	80	59.3
Untreated	0	73.3	0	65.0

Green foxtail was especially prevalent in the oats crop. Inhibition of growth of the weed was more evident than outright killing but the degree of control even at the low rate was good. Analysis indicated that there was no significant effect of treatments on yield. (Experimental Farm, Brandon, Manitoba.)

Granular CDAA, simazin, EPTC, Fenac, Amoben, and Zytron applied preemergence for controlling foxtails in corn. Derscheid, Lyle A. Duplicate 2-row by 60-foot plots were treated May 19 by use of a Gandy row-crop applicator mounted on the corn planter. CDAA and EPTC in granules containing 10% CDAA or 20% EPTC were applied at 3, 4, and 5 lb/A; simazin in 4% granules and 10% 3-amino-2,5-dichlorobenzoic acid (Amoben M-728) at 2, 3, and 4 lb/A; 10% 2,3,6-trichlorophenylacetic acid (Fenac M-816) at 1, 2, and 3 lb/A; and 25% *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron, M-1481) at 8, 12, and 16 lb/A. All were applied in 14-inch bands over the row and all were cultivated on June 19 and July 10.

The soil temperature was 78° F. to a depth of 4 inches and the soil was moist at time of treatment. Precipitation was 0.46 inch the day before treatment, 1.00 inch the afternoon after treatment, 0.23 inch during next 6 days, 1.78 inches during second week and 0.23 inch during third week after treatment. Notes on August 25 indicate that EPTC at 5 lb/A and Amoben at 2, 3 or 4 lb/A reduced the stand of corn. Ninety-five percent elimination of weeds was obtained with 4 lb of simazin, 5 lb of CDAA and 2 or 3 lb of Fenac; 85% was obtained from 3 lb of simazin, 4 lb of CDAA, 1 lb of Fenac and 4 lb of Amoben. CDAA at 3 lb gave 80% kill but all other treatments gave less than 70% kill.

In this experiment the Gandy applicator proved to be an unsatisfactory method of applying these granules in experimental plots and accurate application of the above rates may not have been obtained. Therefore the above results are not conclusive. (Contributed by the Agronomy Department, South Dakota Agr. Exp. Sta., South Dakota State College, Brookings.

Dalapon, amitrol, Atrazine and Zytron applied postemergence for the control of foxtails in corn. Derscheid, Lyle A. Duplicate 6-row plots were sprayed with a logarithmic sprayer using 18 gal/A of spray. Two rows of each plot were not cultivated, 2 were cultivated June 19 and July 10, and 2 were cultivated once at layby on July 10. Dalapon, amitrol and 2-chloro-4-isopropylamino-6-ethylamino-*s*-triazine (Atrazine) were applied at rates of ½ to 4 lb/A and *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron, emulsifiable) was applied at rates of 4 to 16 lb/A. Treatments were applied on June 7, when corn was in 3-leaf stage and foxtails were 2 to 3 in. tall, and June 11, with corn in 5-leaf stage and foxtails 3 to 5 in. tall.

On August 25 dalapon at rates of 1 to 4 lb/A gave 100% control of foxtails in all plots regardless of time of application and regardless of cultivation. However, rates of over 2 lb/A severely injured the corn. Amitrol was more effective at the earlier date of spraying and was more effective when cultivation was used. Rates of 1 to 4 lb/A applied at the 3-leaf stage killed 0, 73 and 95% of the 2-to 3-inch foxtail when followed by 0, 1, and 2 cultivations, respectively; while the same treatment applied to 3-to 5-inch foxtail killed 0, 0, and 73% of the weeds. Although the corn appeared chlorotic shortly after treatment, there appeared to be no ill effects from the amitrol in August. Atrazine was less effective, as 0, 25, and 38% of the weeds were killed by the earlier application, and 10, 25, and 93% by the later application, when followed by 0, 1, and 2 cultivations, respectively. Similar percentages for Zytron emulsifiable were 0, 25, and 43 and 0, 25, and 73, respectively. Zytron also reduced corn stands materially. These results indicate that amitrol may become useful as a post emergence herbicide for controlling annual grassy weeds in corn. (Contributed by Agronomy Department, South Dakota Agr. Exp. Sta., South Dakota State College, Brookings.)

Control of green foxtail in flax with herbicides. Forsberg, D. E. An area of wheat stubble, uniformly infested with green foxtail, was ploughed, packed, and sown to flax. On June 18, when foxtail was in the 2 to 6 leaf stage and flax from 4 to 8 in. high, a randomized, replicated test was given the following treatments: TCA at 16, 32, and 64 oz/A in 10 gal/A water; Dalapon at 4, 8, and 16 oz/A in 10 gal/A water; EPTC (Eptam) granular at 4, 8, and 16 oz/A; Amoben (3-amino-2,5-dichlorobenzoic acid) at 4, 8, and 16 oz/A; and Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) at 4, 8, and 16 oz/A; all with 5 gal/A water. The foxtail infestation was very uniform and a very poor stand of flax was obtained. Due to a dry season, flax yields were very low on all treatments. Highest yields were obtained with dalapon and Amoben and the lowest yields were obtained with TCA treatments. Control of green foxtail was not complete with any of the treatments used. However, dalapon and TCA at all rates suppressed green foxtail to where it was drying up and not giving much competition to the flax. Carbyne, Eptam granular and Amoben did not effect any control of green foxtail. (Contribution by Research Branch, Experimental Farm, Scott, Saskatchewan.)

Effect of pre-emergence sprays on green foxtail. Forsberg, D. E. In the spring of 1959 a test with four replicates was laid out and sprayed with the butyl ester and the butoxyethanol ester of 2,4-D, each at 8, 16, 32, and 64 oz/A. Treatments were applied as top sprays one week after seeding of wheat. Conditions were dry throughout the growing season. The 64 oz rates of both herbicides resulted in a very clean crop. However, yields from these treatments were less than one-half of the check. The 8 oz and 16 oz rates had no effect on green foxtail. The 32 oz rate suppressed green foxtail to where it did not produce seed. With this treatment the butyl ester cut yields by 1.2 bu/A while the butoxyethanol ester cut yields by 5.9 bu/A. (Contribution from the Research Branch, Experimental Farm, Scott, Saskatchewan.)

Effect of herbicides on green foxtail in wheat. Forsberg, D. E. An area of wheat stubble, heavily infested with green foxtail, was sown to wheat in the spring of 1959 and sprayed with the following herbicides when in the 3-leaf stage, with green foxtail in the first true leaf stage: butyl ester of 2,4-D at 5, 8, 16, and 32 oz/A; Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) at 4, 8, and 16 oz/A; Fenac (2,3,6-trichlorophenylacetic acid) at 4, 8, and 16 oz/A; and Trysben (2,3,6-trichlorobenzoic acid) at 4, 8, and 16 oz/A. No treatments in the test had any effect on the green foxtail except butyl ester of 2,4-D at 16 and 32 oz/A. These two rates of 2,4-D suppressed green foxtail to a point where it did not produce seed stalks. However, these rates caused deformities in the grain crop and a reduction in yield of 4.1 bu/A from the 32 oz rate. (Contribution from the Research Branch, Experimental Farm, Scott, Saskatchewan.)

OTHER ANNUAL WEEDS

Herbicides for control of crabgrass. Couchman, John, and Elder, W. C. The experimental area was cultivated several times to encourage weed seed germination. On June 15, 1959, highly viable crabgrass seed was planted on the plots. On June 16, ten herbicides at three different rates were applied in water. Less than ½ inch of water was applied by sprinkler irrigation on June 17 and 18 to encourage rapid grass seed germination. Good rain distribution kept the plots under ideal growing conditions until the grass plants were counted. Percent of

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control was determined by counting the crabgrass plants 27 days after treatment. Simazin at 1 and 2 lb/A, Atrazine (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine) and diuron at 2 lb/A gave 100% control of crabgrass. Monuron at 2 lb/A, diuron at 1 lb/A, neburon at 4 lb/A and Atrazine at 1 lb/A killed 95 to 98% of the grass. Control of 85 to 94% was received from monuron at 1 lb/A, ETPC at 4 lb/A, simazin at ½ lb/A and NPA at 6 lb/A. Tris(2,4 dichlorophenoxyethyl) phosphite (Falone) at 4 and 6 lb/A, neburon at 2 lb/A, EPTC at 2 lb/A, DNBP at 9 lb/A and monuron at ½ lb/A controlled 75 to 84% of the crabgrass. Control of 60 to 74% of crabgrass was given by NPA at 2 and 4 lb/A, Falone at 2 lb/A and Atrazine at ½ lb/A. The following treatments controlled less than 60% of the crabgrass: Diuron at ½ lb/A, CDAA at 2, 4 and 6 lb/A, EPTC at 1 lb/A and DNBP at 3 and 6 lb/A. (Contribution of the Agronomy Department, Oklahoma Agr. Exp. Sta., Stillwater.)

Control of darnel in flax. Forsberg, D. E. The following herbicides were sprayed on darnel in a crop of flax, when darnel was in the 3 to 5 leaf stage and when flax was 4 to 6 inches high: Amoben (3-amino-2,5-dichlorobenzoic acid); EPTC; and dalapon; applied at 4, 8, and 16 oz/A; and TCA applied at 16, 32, and 64 oz/A. Not all treatments used in this test gave satisfactory control at the rates used. However, Amoben and TCA at all rates caused some suppression of darnel. Dalapon at the higher rates gave equivalent suppression. The yield of flax was increased with TCA and Amoben treatments over the check. (Contribution of Research Branch, Experimental Farm, Scott, Saskatchewan.)

The effect of early spray application on wild buckwheat. Forsberg, D. E. Over the past four years wild buckwheat has been sprayed in a field of Chinook wheat when the grain was emerging or in the first leaf stage. At this time the wild buckwheat is usually in the cotyledon stage. In 1959 the following herbicides were used: 2,4-D butyl ester, butoxyethanol ester of 2,4-D, MCPA butyl ester, 4-(MCPB) butyl ester and 4-(2,4-DB) butyl ester. Each of these herbicides was applied at 5, 8, 12, and 16 oz/A, and also at 5 oz/A twice, applied one week apart. In each of the four years that this test has been conducted an analysis of variance of the yield data has indicated no significant differences. The yields from this test over the past 4 years are presented as bu/A in the following table, and the bracketed figures are the average percent kill of wild buckwheat.

Treatment	Yield buckwheat, bu/A and ( ) percent kill of wild buckwheat					
	Rate, oz/A					
	5	8	12	16	32	5+5
2,4-D butyl ester	19(85)	18(87)	17(89)	19(91)		19(89)
Butoxyethanol ester of 2,4-D	19(87)	19(90)	18(89)	17(89)		17(92)
MCPA butyl ester	20(68)	20(75)	18(71)	19(75)		19(78)
4-(MCPB) butyl ester	16(64)		15(66)	14(63)	15(70)	16(61)
4-(2,4-DB) butyl ester	15(65)		13(78)	14(85)	13(89)	13(82)
Av. check yield 18.8 bu/A.						

The best results were obtained by the 2,4-D butyl ester and the butoxyethanol ester of 2,4-D when sprayed at this early date. The butoxyethanol ester has resulted in a little higher degree of buckwheat control. However, at the higher rates the effect on the crop has resulted in lower yields. MCPA butyl ester has given the highest yields but the control of wild buckwheat has not been equal to the 2,4-D butyl ester. 4-(MCPB) butyl ester and 4-(2,4-DB) butyl ester have had more effect on yield of wheat than the esters of 2,4-D and have not given as good control of wild buckwheat. (Contribution from the Research Branch, Experimental Farm, Scott, Saskatchewan.)

The effect of herbicides and combinations of herbicides on wild buckwheat. Forsberg, D. E. In 1959 wild buckwheat was sprayed with a combination of herbicides in a crop of Chinook wheat. The following treatments were applied to the wild buckwheat when in the 1 to 2 true leaf stage: 2,4-D butyl ester and butoxyethanol ester of 2,4-D at 5 and 8 oz/A, each in combination with 2 oz/A of: amitrol (liquid); FB-2 (1,1'diethylene-2,2'-bipyridinium dibromide); Fenac (2,3,6-trichlorophenylacetic acid); and Trysben (2,3,6-trichlorobenzoic acid). Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) was applied at 4, 8, and 16 oz/A in 10 gal/A water. An anlysis of variance showed no significant differences between grain yields. Combinations of butyl ester and butoxyethanol ester with FB-2 and Trysben resulted in better control than with amitrol or Fenac. However, these combinations resulted in lower yields, although not significantly lower. All of the combination treatments resulted in several deformities in the wheat crop. Carbyne did not give control equal to the 2,4-D butyl ester and a slight reduction was noted in wheat yields. (Contribution from the Research Branch, Experimental Farm, Scott, Saskatchewan.)

Herbicides for the control of ladysthumb and hemp nettle. Friesen, H. A. Plots infested with these weeds were sprayed with neburon (Kloben) at 2, 3, and 4 lb/A; CP 1815 (mixture of chlorinated benzoic and cresoxyacetic acids), 2-(MCPP) (Compitox), butyl ester of 2,4-D, and butyl ester of MCPA, each applied at 4 and 8 oz/A; and Trysben 200 (trichlorobenzoic acid), applied at 16 oz/A, alone, and mixed with butyl ester of 2,4-D at 8 oz/A. The infestation of ladysthumb and of hemp nettle averaged 35 plants per square yard for each species. Kloben at all rates, Trysben alone and in mixture with 2,4-D, and the 2,4-D ester at 8 oz/A gave nearly 100% kill of ladysthumb; Kloben and the Trysben mixture gave similar control of hemp nettle. Trysben alone gave only 50% control of hemp nettle. CP 1815 and Compitox at 4 oz/A and MCPA ester at 8 oz/A did not control ladysthumb. Compitox at 8 oz/A resulted in 50% kill of ladysthumb. CP 1815 at 8 oz/A did not kill ladysthumb but reduced its dry weight by some 60%. This treatment gave similar control of hemp nettle. The mixture of Trysben 200 and 2,4-D reduced the yield of barley by nearly 50%, Trysben 200 alone by 20%. Those other treatments which gave good weed control also increased the yield of barley. (Contributed by the Experimental Farm, Lacombe, Alberta.)

Herbicides for chemical summerfallow, 1959. Selleck, G. W. and Gerrie, H. Simazin, 2,3,6-TBA and Atrazine (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine) at rates ranging from 4 lb/A to 0.1 lb/A, and mixed esters of 2,4-D from 8 lb/A to 4 oz/A were applied with a variable-rate sprayer to duplicated, 15 x 135 ft plots at Saskatoon. The application was made June 1 on silty clay loam soil in 34 gal/A of water to weeds which varied between 4 and 8 in. high. One pair of plots was tilled June 1 and subsequent growth was sprayed with 2,4-D July 31. The control of weeds by various herbicides is presented below as a fraction, the numerator representing the rate of application (lb/A) and the denominator the resulting percentage of control.

Weed species	Atrazine			Simazin			TBA			2,4-D June 1			2,4-D July 31
Chenopodium album	1.3	0.6	0.3	0.5	0.4	0.3	1.8	0.8	0.2	2.2	1.4	1.2	0.4
	100	90	75	100	90	75	100	90	75	100	90	75	100
Salsola pestifer	2.0	0.6	0.4	1.2	0.5	0.15	0.3	0.1		2.4	0.7	0.6	0.9
	100	90	75	100	90	75	100	90		100	90	75	100
Axyris amaranthoides	0.7	0.5		1.4	0.7	0.25	0.2	0.1					1.6
	100	90		100	90	75	100	90					100
Amaranthus graecizans	2.5	0.7	0.4	2.7	1.9	0.7	1.8	0.3	0.2	3.4	1.9		2.6
	100	90	75	100	90	75	100	90	75	100	90		100
Portulaca oleracea	2.6	0.4	0.3	1.9	0.6	0.3	1.6	0.7	0.3	2.8	2.1	0.8	0.8
	100	90	75	100	90	75	100	90	75	100	90	75	100
Sweetclover	1.3	0.3	0.2	0.5	0.3		1.6	0.5	0.3	3.8	2.0	1.0	
	100	90	75	100	90		100	90	75	100	90	75	
Polygonum convolvulus	1.3	0.4	0.3				2.2	0.5	0.2	0.8	0.5		
	100	90	75				100	90	75	100	90		

Atrazine, simazin and TBA required only one spraying to maintain annual broad-leaved and grassy weed control throughout the season. The fact that one application of 2,4-D was sufficient to maintain annual broad-leaved weed control on untilled soil may be attributed to the very dry growing season. The July 31 date of spraying of 2,4-D controlled weeds at a similar stage of development with less herbicide. On plots which were treated June, 1958, herbicides inhibited durum wheat and weed growth July 6, 1959, as follows: EPTC $\frac{12}{100}$ $\frac{4.5}{90}$; simazin $\frac{5.8}{98}$ $\frac{1.9}{90}$ $\frac{2.2}{75}$; 2,3,6-TBA, $\frac{8.2}{95}$ $\frac{4.0}{75}$ $\frac{2.6}{25}$; mixture of 20% silvex, 80% dalapon, $\frac{0.7}{100}$. No residual effects were visible on plots which had received two applications of 2,4-D at rates of 8 lb/A. (Contribution No. 279 from the Departments of Plant Ecology and Field Husbandry, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agric. Research Foundation.)

Post-emergence applications of herbicides on rapeseed, 1959. Selleck, G. W. TCA and mixed esters of 2,4-D at 8 lb/A, silvex, CP 1815 (mixture of chlorinated benzoic and cresoxyacetic acids), and dalapon, at 4 lb/A, Diax (93% isopropylamine salt of 2,4-D, 7% isopropylamine salt of citric acid), and mixed amines of 2,4-D at 2 lb/A and neburon at 16 lb/A, initial rates, were applied with a variable-rate sprayer to duplicated, 15 x 135 ft plots on silty clay loam soil, July 9, at Saskatoon. The herbicides were applied in 34 gal/A of water. The rapeseed plants were 5 in. high and weeds varied from 2 to 12 in. high at the time of spraying. Very dry growing conditions during the summer resulted in a thin, short stand of rapeseed. Rates (lb/A) required to provide control (where 10=complete kill and 7=satisfactory control) are presented in the table.

Crop or weed	Rate, lb/A, required to produce designated control													
	2,4-D mixed esters		CP 1815			Diax			Silvex			2,4-D mixed amines	
	7	5	7	5	3	7	5	3	7	5	3	7	5
Rapeseed	6.5	2.5	1.8	0.9	0.5	1.3	0.6	0.3	1.4	0.4	0.2	1.0	0.6
Thlaspi arvense	2.5	1.9	1.4	0.7	—	0.5	0.4	—	0.6	0.2	—	1.3	0.9
Chenopodium album	2.2	—	0.3	—	—	0.5	0.3	—	0.4	0.2	—	—	—
Salsola pestifer	2.9	—	2.0	1.2	1.0	0.9	0.4	—	1.0	0.2	—	0.8	0.6
Axyris amaranthoides	6.0	—	2.0	—	—	—	—	2.0	—	4.0	1.8	—	—
Portulaca oleracea	6.0	—	1.8	—	—	0.7	—	—	2.8	2.0	—	—	—
Lappula echinata	5.0	—	—	—	2.0	—	2.0	—	—	4.0	—	—	—
Kochia scoparia	2.1	1.4	0.8	0.6	—	0.7	0.4	—	0.3	0.1	—	—	—
Brassica arvensis	—	—	—	—	—	—	—	—	—	—	—	0.5	0.3

Neburon, dalapon, and TCA had no significant effects on rapeseed or weeds. (Contribution No. 263 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agric. Research Foundation.)

Various herbicides for annual weed control in legumes, 1959. Selleck, G. W. and Goplen, B. P. Various herbicides were applied to weeds in seedling legume stands with a variable-rate sprayer on duplicated, 15 x 135 ft plots at rates between 8 and 0.2 lb/A, with the exception of neburon, which was applied at rates between 16 and 0.5 lb/A. The herbicides were applied in 34 gal of water, on duplicated, 15 x 135 ft plots, on silty clay loam soil, July 14, at Saskatoon, when the weeds ranged between 4 and 8 in. tall. The degree of control is listed in the table as a range from 1 to 10 where 10=complete kill and 7=satisfactory control. The data are presented in fractions, the numerator representing the rate (lb/A) required to obtain the degree of control indicated by the denominator.

Weeds	Herbicides											
	MCPA ester		2,4-D mixed amines		Na salt MCPB		Na salt 2,4-DB		MCPA mixed amines		Mixed Na salts of MCPA, 2,4-DB	
Portulaca oleracea	2.5	1.0	2.9	1.8	7.0	5.0	7.0	—	3.1	2.0	5.0	3.8
	10	7	10	7	7	5	5		7	5	7	5
Chenopodium album	6.0	0.5	6.0	1.4	2.0	1.2	2.3	1.2	2.0	1.0	2.0	1.0
	10	7	10	7	7	5	7	5	7	5	7	5
Thlaspi arvense	0.5	0.2	3.5	1.0	—	—	—	—	—	—	—	—
	7	5	10	5								
Salsola pestifer	3.0	1.4	2.0	1.0	7.0	6.0	4.3	3.0	6.0	5.0	3.5	2.8
	7	5	7	5	7	5	7	5	7	5	7	5
Axyris amaranthoides	4.2	1.9	3.0	1.8	7.0	3.7	4.6	2.3	4.5	2.8	3.0	2.0
	7	5	7	5	7	5	7	5	7	5	7	5
Capsella bursapastoris	6.0	1.5	1.4	1.0	5.0	—	7.0	—	1.6	0.8	5.0	4.1
	10	7	7	5	5		5		7	5	7	5
Descurainia sophia	3.0	1.5	1.8	0.9	7.0	—	6.7	3.4	2.1	1.5	5.5	4.0
	7	5	7	5	5		7	5	7	5	7	5
Monolepsis nuttalliana	2.0	0.5	2.0	0.5	3.0	1.0	1.0	0.7	1.0	0.6	1.0	0.7
	7	5	7	5	7	5	7	5	7	5	7	5
Solanum triflorum	2.2	1.0	2.3	1.0	6.5	3.0	5.0	3.5	2.5	1.5	3.1	1.7
	7	5	7	5	7	5	7	5	7	5	7	5

Neburon provided satisfactory control of shepherds purse and spear-leaved goosefoot at rates of 7 lb/A and 5 lb/A, respectively, but very little effect was visible on the other weeds at 16 lb/A. (Contribution No. 258 from the Dept. of Plant Ecology, Univ. of Saskatchewan, and the Forage Crops Section, Canada Agr. Res. Sta., Saskatoon, with financial assistance from the Sask. Agr. Research Foundation.)

Several herbicides for weed control in grass seedlings, 1959. Selleck, G. W. and Knowles, R. P. New seedings of bromegrass and crested wheatgrass were sprayed June 12 with mixed amines of 2,4-D, butyl ester of MCPA, sodium salt of 2,4-DB, sodium salt of MCPB, and mixed sodium salts of 2,4-DB and MCPB at rates of 2 lb/A in 34 gal of water. The herbicides were applied to duplicated, 15 x 400 ft plots on silty clay loam soil at Saskatoon. The grasses and weeds ranged in height from 2 to 4 in. at the time of spraying. None of the grasses suffered significant damage from any of the herbicides. The degree of weed control (where 10=complete kill and 7=satisfactory control) is presented below.

Crop or weed	Degree of control by				
	2,4-D	MCPA	2,4-DB	MCPB	2,4-DB-MCPB
Sweetclover	6	6	3	2	2
Salsola pestifer	7	5	1	1	5
Chenopodium album	7	7	6	7	6
Portulaca oleracea	5	7	1	1	1
Axyris amaranthoides	1	5	1	1	1
Lappula echinata	7	7	1	4	5
Thlaspi arvense	7	7	7	7	7
Descurainia sophia	7	7	5	7	6
Capsella bursa-pastoris	7	7	1	2	1

(Contribution No. 259 from the Dept. of Plant Ecology, Univ. of Saskatchewan, and the Forage Crops Lab., Canada Dept. of Agr., Saskatoon, with financial assistance from the Sask. Agr. Research Foundation.)

WEED CONTROL IN FIELD CROPS

CORN

A comparison of granular and liquid formulations of herbicides on corn. Agundis, Omar, and Bondarenko, D. D. Hybrid C-38 corn was planted in 36-inch rows in a Miami-Brookston silty clay loam at Columbus on May 26, 1959. Three series of plots were laid out—band-treated and rotary-hoed, band-treated and not rotary-hoed, and herbicides applied overall and not rotary-

hoed. Each series included 2,4-D at 1, 2, and 4 lb/A, 2,4-D+CDAA at 1+2 and 2+2 lb/A and simazin at 1, 2, and 4 lb/A, each in liquid and granular formulations, applied pre-emergence to quadruplicate plots on May 27 and 28. The liquid 2,4-D was the isopropyl ester, the granular, 2,4-D acid. The liquid and wettable powder (wp) formulations were applied in 40 gpa water. The granular formulations were applied by a Gandy spreader. The plots had a natural infestation of lambsquarters, redroot pigweed, green foxtail, and crabgrass. In addition, German millet at 20 lb/A was sown in the not-rotary-hoed series of band-treated plots. The rotary-hoed series was hoed on June 4. On July 2 ryegrass and yellow sweetclover, each at 10 lb/A, were interseeded in the series treated overall and in the rotary-hoed band-treated series. Dry weather prevailed during the growing season.

On June 25 the plots treated overall and in bands by simazin wp at 2 lb/A, simazin wp and granular at 4 lb/A, the mixture of 2,4-D+CDAA liquid at 1+2 lb/A and 2,4-D+CDAA liquid and granular at 2+2 lb/A showed 90% or more reduction in weed stand; simazin granular at 2 lb/A, 2,4-D+CDAA granular at 1+2 lb/A and 2,4-D liquid at 1 lb/A, 80-89%; the other treatments, 70-79%. The plots that were band-treated and then rotary-hoed one week later showed somewhat better weed control than those not hoed. All the treated plots that were rotary-hoed showed a 90% or more reduction in weed stand except those treated with 2,4-D granular at 1 lb/A and 2,4-D+CDAA granular at 1+2 lb/A, both of which reduced the weed stand 75-80%.

The plots treated with 2,4-D alone and in combination with CDAA showed slight damage to the corn early in the season, but the yield of corn was not affected. The yields of the plots treated by the granular formulations of all the herbicides were similar to those treated by the corresponding liquid or wettable powder formulations. All of the band-treated plots, including the checks, that were rotary-hoed yielded somewhat higher than the corresponding plots that were not rotary-hoed.

The effect of the treatments on the interseeding will be evaluated in the spring of 1960. (The Ohio Agr. Exp. Sta.)

Pre- and post-emergence weed control in corn on muck soil. Egley, G. H., Schweizer, E. E., and Rogers, B. J. Pioneer 7072 corn was planted May 29, 1959, in muck soil in north central Indiana. Pre-emergence treatments were made June 2. Rainfall was 0.29 in. May 26, 0.20 in. May 31, 0.43 in. June 11-12, 0.10 in. June 16, and 0.66 in. June 26. Fair to good control of annual broadleaves and grasses resulted from EPTC liquid and granular at 6 lb/A; simazin at 3 lb/A and 2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine (Atrazine) at 4 lb/A; and 2,4-D (PGBE ester) at 4 lb/A. Lower rates of the above, simazin granular at 3 and 4 lb/A, triethylamine salt of 3-amino-2,5-dichlorobenzoic acid at 3 and 6 lb/A, tris(2,4-dichlorophenoxyethyl) phosphite (Falone) at 6 and 8 lb/A, granular 2,4-D acid at 4 lb/A, sodium 2,3,6-trichlorophenylacetate at 2 and 4 lb/A, and CDAA at 4 lb/A gave poor to fair results. Post-emergence treatments were made June 6 at the 2-leaf corn stage. Atrazine at 2 lb/A gave good control; amitrol at 1 lb/A was fair. In general, it seems that rates on muck soil should be 50-100% higher than those used on mineral soil. (Dept. of Botany and Plant Pathology, Purdue Univ. Agr. Expt. Sta.).

Comparisons of granular and liquid applications of herbicides for weed control in corn. Fletchall, O. Hale and Schweiss, Leland W. Corn was planted May 12 on Mexico silt loam which was naturally infested with water hemp, lambsquarters, crabgrass, giant foxtail and yellow foxtail. The experiment consisted of four replications with a split plot design. Herbicides were main plots and formulations, granules or liquid, were subplots. All pre-emergence treatments of granular and spray formulations were applied at the same rate in each comparison on May 13, 1959. The soil was very moist at the time of application. The rainfall for the week preceeding and the week following application was 0.89 and 2.51 inches, respectively. None of the plots were cultivated.

Yields of weeds at harvest comparing granules and liquid applications, respectively, were as follows: 1½ lb/A 2,4-D butylethanol ester, 3900 and 4400 lb/A; 1½ lb/A 2,4-D acid, 4000 and 4300 lb/A; 2 lb/A 2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine (Atrazine), 250 and 200 lb/A; 2 lb/A simazin, 350 and 50 lb/A; 4 lb/A tris(2,4-dichlorophenoxyethyl) phosphite (Falone), 4600 and 3850 lb/A; 6 lb/A Falone, 4100 and 3500 lb/A; 2 lb/A silvex, 3400 and 1800 lb/A; 2 lb/A neburon, 2600 and 1200 lb/A; 10 lb/A *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate, 2150 and 1250 lb/A; 3 lb/A EPTC incorporated by shallow disking after planting, 2650 and 3500 lb/A; 2 lb/A 2,3,6-TBA dimethylamine salt granules and 2 lb/A 2,3,6-TBA sodium salt liquid, 1050 and 900 lb/A.

The average extended leaf height of corn on June 13, 1959 in the granular treated plots with 3 lb/A EPTC was 33 inches and in the liquid treated plots, 39 inches. Slight reductions in extended leaf heights were also noted in corn receiving 4 and 6 lb/A of Falone in either formulation. (Contribution of the Missouri Agr. Exp. Sta.)

Control of weeds in corn with herbicides used pre-emergence. Freeman, J. F. Ky. 105 corn was planted in Captina silt loam soil at Lexington May 25, 1959, and in Falaya local alluvium silt loam soil at Henderson June 4. Principal weeds at Lexington were redroot pigweed, crabgrass and foxtail, and at Henderson redroot pigweed, annual morning glory, crabgrass and foxtail. Four-row plots with treatments quadruplicated at Lexington and triplicated at Henderson were band-sprayed over the row at rate of 39 gal/A, solid coverage basis. Actual rate of spray and herbicides used was ⅓ that of solid coverage rate, the width of treated bands being only ⅓ that of the distance between rows. Herbicide rates solid coverage basis, are given below. The herbicides used were: sodium salt of 2,3,6-trichlorophenylacetic acid (Fenac-S); tris(2,4-dichlorophenoxyethyl) phosphite (Falone); tris(2-methyl-4-chlorophenoxyethyl) phosphite (B-528); *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron); simazin; 2-chloro-4-isopropylamino-6-ethylamino-*s*-triazine (Atrazine); neburon; EPTC, incorporated with soil 2″ depth; dimethylamine salt of 2,3,6-TBA plus CDAA; PGBE ester of 2,4-D, (delayed at Lexington until 1 day before corn emerged); cultivated check; and uncultivated check. Heavy rains occurred at Lexington after corn emerged and at Henedrson 1 day after treatment. At Lexington none of the herbicides affected stand or early growth of corn, but at Henderson, Falone, B-528 and 2,4-D injured corn an estimated 15 to 20% and EPTC 40%. The number of weeds in a 9″ row-band of 2 inside rows of each plot was determined 1st week of July at Lexington and 3rd week of July at Henderson. Based on the number of weeds present on the uncultivated check [36/sq ft (19 grass + 17 broadleaf) at Lexington and 15/sq ft (10 grass + 5 broadleaf) at Henderson], the weed population was reduced by treatments as follows: Fenac, ½, 1, and 2 lb/A at Lexington 69, 88, and 96%, respectively, and 1 lb/A at Henderson, 87%; Falone, 2, 4, and 6 lb/A at Lexington 77, 84, and 86%, and 4 lb/A at Henderson 60%; B-528, 3, 4, and 6 lb/A at Lexington 80, 81, and 91%, and 4 lb/A at Henderson, 83%; Zytron, 5, 10, and 15 lb/A at Lexington only, 36, 63, and 60%; simazin 2 and 3 lb/A at Lexington, 94 and 97%, and 2 lb/A at Henderson, 98%; Atrazine, 2 and 3 lb/A at Lexington, 89 and 92%, and 2 lb/A at Henderson, 98%; neburon, 1½ lb/A at Lexington 39%; EPTC 2, 3, and 4 lb/A at Lexington 71, 93 and 91%, and 3 lb/A at Henderson 90%; 2,3,6-TBA plus CDAA, 1 + 2 lb/A at Lexington 46%; 2,4-D, 2 lb/A applied 1 day before emergence at Lexington, 74%, and at time of planting at Henderson 53%; and cultivated check at Lexington, 90%. (Department of Agronomy, Kentucky Agr. Exp. Sta.)

Herbicides used early postemergence in corn. Freeman, J. F. Ky 105 corn was planted in Burgin silt loam

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soil at Lexington, Ky. June 12, 1959. Herbicide treatments were made on 4-row plots in quadruplicate June 18, two days after corn began to emerge, most corn being in late spike stage. At time of treatment weeds, mostly red-root pigweed, crabgrass, and foxtail, had not emerged due to dry weather which continued for 3 days afterward. Herbicide sprays were applied in 13⅓" bands centered over 40-inch rows at 39 gal/A, solid coverage basis. Treatment rates (solid coverage basis) are given below. Herbicides applied were: 2 chloro-4-isopropylamino-6-ethylamino-*s*-triazine (Atrazine); diuron; 1-chloro-*N*-(3,4-dichlorophenyl)-*N*,*N*-dimethylformamidine (duPont 685) (kerosene used as carrier); neburon; alkanolamine salt of DNPB plus sodium salt of dalapon; alkanolamine salt of 2,4-D plus dalapon; dimethylamine salt of 2,3,6-TBA; amitrol; cultivated and uncultivated checks. No reduction in stand or injury to the corn by herbicides was found at maturity. The number of weeds in the treated row-band of all plots was determined 4 weeks after treatment. Based on the number of weeds in the untreated check, 8.4/sq ft (3 grass + 5.4 broadleaf), the treatments reduced the number of weeds as follows: Atrazine 2 and 3 lb/A, 98 and 99%; diuron, 0.5 lb/A, 89%; duPont 685, 0.5 and 1 lb/A, 89 and 95%; neburon, 1.5 lb/A, 86%; mixture of DNBP and dalapon, 56%; mixture of 2,4-D and dalapon 79%; 2,3,6-TBA, 1 and 2 lb/A, 88 and 89%; amitrol, 0.75 and 1 lb/A, 13 and 0%; and cultivated check, 89%. (Department of Agronomy, Kentucky Agr. Exp. Sta.)

Preemergence weed control in corn on mineral soil. Rogers, B. J. and Schweizer, E. E. Pioneer 301B corn was planted June 2, 1959, in a Chalmers silt loam soil. Treatments were made June 4-5. Rainfall was 0.67 May 27, 1.03 in. June 11, and 0.98 in. July 18. The PGBE ester of 2,4-D at 2 lb/A; 2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine (Atrazine) at 3 lb/A (wettable powder) and 2 lb/A (granular); and CDAA at 2, 3, and 4 lb/A plus trichlorobenzyl chloride or trichlorotoluene at 5, 7.5, and 10 lb/A or plus 2,3,6-trichlorobenzoic acid at 0.5 lb/A gave fair to good control of broadleaves and grasses. Herbicides which did not do well were butoxyethanol ester of 2,4-D (granular) at 2 lb/A; CDAA at 4 lb/A; dimethyl 2,3,5,6-tetrachloroterephthalate at 4 and 8 lb/A; *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate at 13 lb/A; simazin (wettable powder) at 1, 2, and 3 lb/A; simazin (granular) at 2 lb/A; tris(2,4-dichlorophenoxyethyl) phosphite at 2 and 4 lb/A; sodium 2,3,6-trichlorophenylacetate at 1.5 and 3 lb/A; EPTC at 3 lb/A (liquid and granular); and alpha-chloro-*N*,*N*-dimethylacetamide at 4 lb/A. Undoubtedly the dry conditions influenced the results. (Dept. of Botany and Plant Pathology, Purdue Univ. Agr. Expt. Sta.).

Herbicides on corn. Stroube, E. W. and Bondarenko, D. D. Hybrid C38 corn was planted in 42-inch rows in Miami-Brookston silty clay loam at Columbus on May 22, 1959, and hybrid W-64 corn in Hoytville clay loam at the Northwest Substation, Hoytville, on May 28. German millet was sown in the plots at Hoytville to simulate annual grasses. There was a natural infestation of smartweed and common ragweed at Hoytville. At Columbus the plots had a natural infestation of crabgrass, redroot pigweed, lambsquarters and purslane. At Hoytville the herbicides were applied in a 21-inch band over the rows, and overall at Columbus. All herbicides were applied in 40 gpa water except the granular materials, which were applied dry.

Pre-emergence at Columbus and Hoytville: simazin at 1 and 2 lb/A; Atrazine (2-chloro-4-isopropylamino-6-ethylamino-*s*-triazine) at 1, 2 and 3 lb/A; 2,3,6-TBA at 1½ and 3 lb/A; Fenac (sodium 2,3,6-trichlorophenylacetate) at 2 and 4 lb/A; Falone (tris(2,4-dichlorophenoxyethyl) phosphite) at 4 and 6 lb/A; diuron at 2 pt/A (as sold); CDAA at 4 lb/A; and EPTC at 3 and 4 lb/A. Also applied at Columbus were Randox-T (CDAA + trichlorobenzyl chloride) and neburon at 4 lb/A, and at Hoytville, isopropyl ester of 2,4-D at 1½ and 2 lb/A and isopropyl ester of 2,4-D plus CDAA at 1 + 2 and 2 + 2 lb/A.

At emergence, only at Hoytville: simazin at 1 and 2 lb/A; Atrazine at 1,2 and 3 lb/A; amitrol at ¾ and 1 lb/A; 2,3,6-TBA at 1½ and 3 lb/A; alkanolamine salts of 2,4-D plus dalapon at ½ + 1 and ½ + 2 lb/A; isopropyl ester of 2,4-D at 1 and 2 lb/A; isopropyl ester of 2,4-D plus CDAA at 1 + 2 lb/A; and diuron (as sold) at 2 pt/A.

2- to 4-leaf stage at Columbus and 5- to 7-leaf stage at Hoytville: amitrol and Amitrol-T (amitrol plus ammonium thiocyanate) at ¾ and 1 lb/A; Atrazine at 1, 2, and 3 lb/A; alkanolamine salts of DNBP at 3 lb/A; diuron (as sold) at 2 pt/A; PGBE ester of 2,4-D at ¼ lb/A; alkanolamine salts of 2,4-D at ½ lb/A and 2,3,6-TBA at 1½ and 3 lb/A.

Pre-emergence results: simazin reduced the weed population 95% or more at Columbus, was unsatisfactory at Hoytville; Atrazine nearly 100% at Columbus, 60 to 80% of broadleaf weeds but poor on millet at Hoytville; Fenac at 2 and 4 lb/A, 90% or more at Columbus, 70 to 80% at Hoytville; 2,3,6-TBA at 1½ and 3 lb/A 90% or more at Columbus, 70% or less at Hoytville; Falone, CDAA and diuron gave excellent weed control at Columbus, but poor control at Hoytville; EPTC gave poor control at both locations; neburon, 95% or more at Columbus (not applied at Hoytville).

At emergence, only at Hoytville: Atrazine reduced the stand of broadleaf weeds 60 to 90% but gave poor control of grasses. Amitrol at 1 lb/A and 2,3,6-TBA at 3 lb/A reduced the weed stand 80% or more and gave fair to poor weed control at the lower rates. 2,4-D plus dalapon at ½ + 2 lb/A reduced the weed stand 75 to 85% and gave poor control at ½ + 1 lb/A. 2,4-D alone and mixed with CDAA gave unsatisfactory control of millet but gave excellent control of the broadleaf weeds. Simazin and diuron gave poor weed control.

2- to 4-leaf stage at Columbus and 5- to 7-leaf stage at Hoytville: amitrol and Amitrol-T gave 80 to 95% reduction in stand of weeds at both locations; Atrazine at 1, 2, and 3 lb/A, 85 to 100% all weeds at Columbus, good weed control only at 3 lb/A at Hoytville; DNBP 95% or more at Columbus, unsatisfactory at Hoytville; diuron 80 to 90% at Columbus, 85% of broadleaf weeds but ineffective on millet at Hoytville; 2,3,6-TBA, satisfactory at both locations except poor on millet at Hoytville; all 2,4-D treatments excellent on broadleaf weeds except purslane, but ineffective on grasses.

On July 2, amitrol, Amtrol-T and 2,3,6-TBA applied at the 5- to 7-leaf stage at Hoytville and DNBP at the 2- to 4-leaf stage at Columbus showed slight damage to the corn, but it recovered completely. None of the other treatments injured the corn. (The Ohio Agr. Exp. Sta.)

SORGHUM

Herbicides for weed control in grain sorghum. Robinson, R. G., Thompson, R. L., and Thompson, J. R. Cultivation alone cannot be depended upon to satisfactorily control weeds in grain sorghum in Minnesota. Trials conducted from 1957-1959 at Rosemount, 1957-58 at Waseca, and 1958-59 at Morris have shown that CDAA at 4 to 6 lb/A pre-emergence in addition to normal cultivation is usually necessary for satisfactory weed control and crop yield. Yields of the 1959 crop have not yet been determined but are expected to be in agreement with 1957-58 results. CDAA at 6 lb/A has given better weed control than 4 lb/A especially where rough pigweed or lambsquarters were numerous, but for *Setaria* spp. the 50% increase in herbicide cost did not pay. A post-emergence spray of ¼ to ½ lb 2,4-D, amine, was a more economical method of getting non-grass weed control.

Time of application was usually of minor importance, so band spraying at planting time is most practical; however, when emergence of sorghum was delayed by cold weather, injury occurred but sorghum recovered.

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Under these cold conditions, delayed pre-emergence gave satisfactory weed control and no sorghum injury in contrast with less satisfactory results from application at planting time.

Simazin at 2 to 4 lb/A either pre- or post-emergence gave good weed control but sometimes injured sorghum so that yield increases were not always obtained. In 1959 at Morris, 2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine or 2-chloro-4,6-bis(isopropylamino)-*s*-triazine at 2 lb/A gave somewhat better grass weed control than simazin. None of the triazine compounds injured sorghum.

In 1959 at Morris, 2,3,6-trichlorophenylacetic acid, sodium salt, at 2 lb/A pre-emergence killed sorghum and 3-amino-2,5-dichlorobenzoic acid, triethylamine, at 2 lb/A gave severe injury but the sorghum recovered.

In 1959 at Rosemount, 4 lb/A CDAA plus 10 lb/A of either trichlorobenzyl chloride or trichlorotoluene gave slightly better control of *Echinochloa crusgalli* than did CDAA alone. CDAA pre-emergence plus simazin at the 5-leaf stage gave complete all-season weed control in this trial.

Spraying the lower 6 inches of row after sorghum heads appeared with dalapon 1 lb/A, amitrol 2 lb/A, or DNBP 4 lb/A failed to give any yield increase and only dalapon prevented seed production of large grass weeds. (Contribution from the Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, West Central School and Station, Morris, and Southern School and Station, Waseca. Paper No. 4254, Sci. Jour. Series, Minnesota Agr. Exp. Sta.)

Pre-emergence herbicides for annual weed control in grain sorghum. Rogers, B. J., and Schweizer, E. E. RS 610 sorghum was sown in 7 in. rows in Chalmers silt loam soil on June 2, 1959. Treatments were made June 5. Rainfall was 0.67 in. May 27, 1.03 in. June 11, and 0.98 in. July 18. Simazin and 2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine (Atrazine) at 2 and 3 lb/A; tris(2,4-dichlorophenoxyethyl) phosphite (Falone) at 2 lb/A; neburon at 2 and 4 lb/A; dimethyl 2,3,5,6-tetrachloroterephthalate at 8 lb/A; and sodium PCP at 20 and 25 lb/A resulted in poor to fair control of broadleaves and grasses. The PGBE ester of 2,4-D at 2 lb/A; triethylamine salt of 3-amino-2,5-dichlorobenzoic acid at 3 lb/A; sodium 2,3,6-trichlorophenylacetate at 1.5 and 3 lb/A; and CDAA at 4 lb/A resulted in fair to good control. It is probable that the dry conditions influenced the results. The 2,4-D ester, Falone, and the trichlorophenylacetate reduced the sorghum stand by 20-30%. (Dept. of Botany and Plant Pathology, Purdue Univ. Agr. Expt. Sta.).

Pre-emergence weed control in grain sorghum. Talbert, Ronald E., and Fletchall, O. Hale. Westland grain sorghum was planted and treated on May 16, 1959 at Columbia, Missouri on Putnam silt loam soil. Rain occurred that night and over three inches of rain fell during the two-week period following treatment. The plots were two 40-inch rows 30 feet long and there were four replications.

None of the plots in this test were cultivated. Weeds infesting the plots included smartweed, common ragweed, rough pigweed, ivy-leaved morning glory, crabgrass, fall panicum, and yellow nutgrass. Percent soil not covered by weeds was recorded six weeks after planting. The untreated check gave 0% soil not covered by weeds; neburon at 1, 2, 3, 4, and 8 lb/A gave 10, 50, 71, 83, and 94%, respectively; neburon at 2 lb/A in 4% granules gave 12%; amitrol at 8 and 12 lb/A, 4 and 14%; PCP, sodium salt, at 20 lb/A, 70%; CDAA at 4 lb/A, 16%; 3-amino-2,5-dichlorobenzoic acid (Amoben) at 2, 3, and 4 lb/A, 59, 75, and 83%; simazin at 1 and 2 lb/A, 83 and 88%; 2-chloro-4-isopropylamino-6-ethylamino-*s*-triazine (Atrazine) at 1 and 2 lb/A, 85 and 92%; 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine (Trietazine) at 2 lb/A, 84%; 2-chloro-4,6-bis(isopropylamino)-*s*-triazine (Propazine) at 2 and 4 lb/A, 71 and 75%; 2-chloro-4-isopropylamino-6-methylamino-*s*-triazine (G-30026) at 2 lb/A, 86% and CDAA at 2 lb/A plus 2,3,6-TBA at 1 lb/A, 34% of soil not covered. Yellow nutgrass was not adequately controlled by any of the herbicides tested and was very prevalent in those treatments which gave the best annual weed control.

Significant sorghum stand reductions as compared to the untreated check resulted from the following treatments: neburon at 4 and 8 lb/A, CDAA at 4 lb/A, Amoben at 3 and 4 lb/A, simazin at 1 and 2 lb/A, Atrazine at 2 lb/A. Trietazine at 2 lb/A, and CDAA at 2 lb/A plus 2,3,6-TBA at 1 lb/A. (Contribution of the Missouri Agr. Exp. Sta.)

Effect of foliage applications of herbicides to RS 610 sorghum. Wiese, A. F. and Rea, H. E. Weed-free RS 610 sorghum grown on level borders of Pullman silty clay loam soil was treated with the following herbicides when the crop was 14 inches tall: butoxyethanol ester of 2,4-D at ½; amitrol at ½, 1, 2, and 4; amitrol plus ammonium thiocyanate (Amitrol-T) at ½, 1, 2, and 4; sodium salt of 2,3,6-trichlorophenylacetic acid at ½, 1, and 2; propylene glycol butyl ether (PGBE) ester of silvex at ½ and 1; and 2-choloro-4,6-bis(isopropylamino)-*s*-triazine (Propazine) at 1, 2, 4, and 8 pounds per acre. Rainfall and irrigation for the crop totaled 24 inches.

The check yielded 6720 pounds per acre. The LSD at the 5% level was 650 pounds per acre. Herbicides and rates per acre which did not reduce the yield below the check were: butoxyethanol ester of 2,4-D at ½; amitrol at ½, 2 and 4; Amitrol-T at ½ and 1; sodium 2,3,6-trichlorophenylacetate at ½; PGBE ester of silvex at ½; Propazine at 1 and 2. Amitrol was objectionable because it turned the sorghum white. (Contribution from the Southwestern Great Plains Field Station, Bushland, Texas. Texas Agr. Exp. Sta. and USDA, cooperating. Approved as TAES T.A. 3356.)

SOYBEANS

A comparison of granular and liquid formulations of herbicides on soybeans. Agundis, Omar, and Bondarenko, D. D. Amoben (3-amino-2,5-dichlorobenzoic acid) at 2 and 4 lb/A, NPA at 4 lb/A, CIPC at 8 lb/A and a mixture of NPA + CPIC at 2 + 2 and 3 + 3 lb/A, each in liquid and granular formulations, were applied pre-emergence on Lincoln soybeans planted on May 6 and June 3. The soybeans were planted in 36-inch rows in a Miami-Brookston silty clay loam. Quadruplicate 4-row plots, 28 feet long, were treated overall with each rate of each herbicide. The liquid formulations were applied in 40 gpa water, the granular materials by a Gandy spreader. The plots had a natural infestation of redroot pigweed, lambsquarters, green foxtail and crabgrass.

A total of 3.88 inches of rain fell in the 3 weeks following treatment of the early soybeans and 0.87 inch in the 3 weeks following treatment of the late planting.

On July 7 the early soybeans treated by NPA + CIPC liquid at 2 + 2 lb/A and Amoben liquid and granular at 2 and 4 lb/A showed a 90% or more reduction in weed stand. The other treatments reduced the weed stand 80 to 89%. The soybeans treated by NPA alone and in combination with CIPC showed slight damage early in the season but they recovered completely.

On the late soybeans the herbicides were less effective due to dry weather. CIPC liquid and granular at 8 lb/A and Amoben granular at 4 lb/A reduced the weed stand 60-69%, the other treatments, 59% or less. None of the treatments damaged the late soybeans. (The Ohio Agr. Exp. Sta.)

Effectiveness of 2,5-dichloro-3-aminobenzoic acid in controlling weeds in soybeans. Behrens, R. On May 22, 1959, pre-emergence applications of 2,5-dichloro-3-aminobenzoic acid at rates of 2, 4, 6, and 8 lb/A were applied to triplicated plots of a Waukegan silt loam soil at Rosemount, Minnesota, on the day after the area had been planted to Chippewa soybeans. Evaluations of weed control and soybean response were made 30 days after

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treatment. Soybeans appeared slightly stunted on plots subjected to the 6 and 8 lb/A application rates. Control of broadleaf weeds including *Amaranthus retroflexus, Chenopodium album, Polygonum persicaria* and *Ambrosia artemisiifolia* was estimated at 85, 90, 95 and 95% for the 2, 4, 6, and 8 lb/A application rates, respectively. Control of grasses including *Echinochloa crusgalli* and *Setaria* spp. was estimated at 55, 70, 80, and 85% for the 2, 4, 6, and 8 lb/A application rates, respectively. Granular applications were equal to spray applications in effectiveness. (Contribution from the Department of Agronomy and Plant Genetics, Univ. of Minnesota, St. Paul. Paper No. 4252, Sci. Jour, Series, Minn. Agr. Expt. Sta.)

Pre-emergence weed control in soybeans at Poneta, Indiana. Bush, D. A. and Carter, Earl. Soybeans (Clark variety) were planted May 20, 1959, in 40" rows on a silt loam soil. Herbicide treatments were made May 25, 1959 as the soybeans and weeds were just emerging. All treatments were applied with a knapsack sprayer at 32 psi in 40 gal water per acre. Plots were 2 rows ,treated 45 feet long, with every third row unsprayed as a control plot, so that each sprayed plot was between two control rows. All treatments were replicated 3 times using a randomized block design. The surface soil was dry at time of application with good subsoil moisture. The temperature was 80°F on application date. Treatments included Amiben (3-amino-2,5-dichlorobenzoic acid, triethylamine salt) at rates of 1, 2, 3, 4, and 8 lb/A; CDAA at rates of 2, 4, and 6 lb/A; uncultivated check; and normally cultivated check. 1.5 in. of rain fell May 28, 1959. The plot area was quite uniform and heavily infested with annual grass and broadleaf weed species. The more prevalent weed species included giant foxtail, annual ragweed, redroot pigweed, velvet leaf and lambsquarters with scattered and lesser populations of jimsonweed, cocklebur, crabgrass, and green foxtail. All plots were evaluated as to weed control and bean injury on July 10, 1959. No bean injury was experienced with any compound with the exception of a slight retarded growth of the beans on the 8 lb rate of Amiben. This stunting was temporary, however, and the beans were normal after a period of 4 to 6 weeks. Yields were obtained October 1, 1959.

Treatment	Rate lb/A	Overall weed control* Grasses	Broadleaf	Bean yield bu/A
Amiben	1	F	F to G	25.0
Amiben	2	G to VG	G	30.2
Amiben	3	Ex	VG to Ex	30.9
Amiben	4	Ex	Ex	32 3
Amiben	8	Ex	Ex	33.3
Uncult. ck.	—	None	None	17.3
Cult. ck.	1 Rot. hoe 2 Cult.	P to F	P to F	19.8
CDAA	2	F	P	20.8
CDAA	4	G	P	22.7
CDAA	6	VG	F to P	24.8

* Scale of rating in terms of per cent weed control and average of 3 reps: P = 50 to 70%; F = 70 to 85%; G = 85-95%; VG = 90 to 95%; Ex = 95 to 100%. Yield data computed on field moisture content of beans at harvest. Moisture tests showed all samples to be from 11.8 to 11.9% moisture at harvest time. (Contribution from Amchem Products, Inc. and Poneto Elevator, Poneto, Indiana.)

Control of weeds in soybeans with pre-emergence herbicides. Freeman, J. F. Soybeans (Clark variety) were planted in Captina silt loam soil at Lexington June 12, 1959 and in Falaya local alluvium silt loam at Henderson June 4. Principal weeds at Lexington were redroot pigweed, crabgrass, and giant foxtail and at Henderson, roodroot pigweed, annual morning glory, crabgrass, and foxtail. Four-row plots quadruplicated at Lexington and triplicated at Henderson were band-sprayed over the row following planting with 39 gal/A solid coverage basis. Actual rate of spray and herbicides was one-third that of solid coverage—the width of treated bands being only ⅓ that of distance between rows. Rates are given below. Herbicides applied were: sodium salt of NPA; NPA plus CIPC; CDAA; triethylamine salt of 3-amino-2,5-dichlorobenzoic acid (Amoben); *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron); sodium salt of PCP; 2-methoxy-4,6-bis(isopropylamino-*s*-triazine (Methoxy Propazine); EPTC, surface application; alkanolamine salt of DNBP, post-emergence at cotyledon stage; cultivated check (Lexington only); and untreated check. Dry soil conditions prevailed at Lexington until 4 days after emergence of soybeans. Heavy rains fell 1 day after treatment at Henderson. The only treatments resulting in apparent injury to the crop when rated, 3rd week of July, were: at Lexington, Methoxy Propazine 4 and 6 lb/A caused 25 and 85% damage; and at Henderson, Amoben 4 lb/A 20% damage, and EPTC, 3 lb/A, 10% damage. The number of weeds in the treated bands was determined near mid-July. Based on number of weeds present in uncultivated check treatment—14 weeds/sq ft (8 grass + 6 broadleaf) at Lexington and 15/sq ft (11 grass + 4 broadleaf) at Henderson, weed stands were reduced by treatments (rates solid coverage basis) as follows: NPA 4 lb/A at Lexington, 75%, and 2 and 4 lb/A at Henderson, 40 and 40%, respectively; mixture NPA and CIPC 2 + 2 lb/A, 76% at Lexington, and 50% at Henderson; CDAA, 4 lb/A, 52% at Lexington and 30% at Henderson; Amoben 2, 4, and 6 lb/A at Lexington 80, 75, and 91%, and 4 lb/A at Henderson 87%; Zytron, 3, 5, and 7 lb/A at Lexington 59, 40, and 78% and 5 lb/A at Henderson 62%; PCP, 20, 25, and 30 lb/A Lexington, 94, 80, and 92% and 25 lb/A at Henderson, 83%; Methoxy Propazine, 2, 4, and 6 lb/A at Lexington 93, 95 and 99%; EPTC, 3 lb/A at Henderson, 67%; DNBP, 2.25 lb/A at cotyledon stage of soybeans, before weeds emerged, at Lexington, 0%; and once-cultivated check at Lexington, 54%. (Department of Agronomy, Kentucky Agr. Exp. Sta.)

Evaluation of pre-emergence herbicides for weed control in soybeans. Peters, E. J., and Davis, F. S. Pre-emergence herbicides were applied to Clark soybeans on May 13, 1959, on Mexico silt loam. Materials and rates per acre were as follows: 20 lb PCP, sodium salt; 4 lb CDAA; 4 lb NPA; 2 and 4 lb Simatone [2-methoxy-4,6-bis(ethylamino)-*s*-triazine]; 2, 4, and 6 lb Trietazine (2-chloro-4-ethylamino-6-diethylamino-*s*-triazine); and 2, 4, and 6 lb of Amoben (3-amino-2,5-dichlorobenzoic acid). All materials were applied in 40 gallons of water and in addition 4 lb/A of Amoben was applied as a granular material. Weeds present were pigweeds, velvet leaf, carpetweed, crabgrass, and foxtails. The most satisfactory treatments were Amoben at 4 lb and sodium PCP at 20 lb. These materials controlled weeds for 6 or 8 weeks without injury to soybeans. The granular formulation of Amoben was about as effective as the liquid for weed control. Stunting of soybeans occurred with the 6-lb rate of Amoben, although weed control was good throughout the season. Weed control with NPA was excellent, but the soybeans were stunted. Trietazine seriously reduced the soybean stands at all rates. CDAA and Simatone failed to control weeds.

(Contribution of the Crop Research Division, A.R.S.-U.S.D.A. and Missouri Agr. Exp. Sta., cooperating.)

Pre-emergence treatments for annual weed control in soybeans. Schweizer, E. E., Rogers, B. J., and Egley, G. H. Harosoy soybeans were planted June 2, 1959, in a Chalmers silt loam soil. Treatments were made June 4. Rainfall was 0.67 in. May 27, 1.03 in. June 11, and 0.98 in. July 18. CDAA at 4 lb/A; dimethyl 2,3,5,6-tetrachloroterephthalate at 4 and 8 lb/A; *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron) at 10 lb/A; sodium NPA granular at 4 lb/A; sodium NPA at 2

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and 3 lb/A plus CIPC at 2 and 3 lb/A; and triethylamine salt of 3-amino-2,5-dichlorobenzoic acid at 3 and 4 lb/A gave fair to good control without injury. CIPC at 4 lb/A; ethyl ethyl-*n*-butylthiolcarbamate, propyl ethyl-*n* butylthiolcarbamate, and propyl di-*n*-propylthiolcarbamate at 4 lb/A; diphenylacetonitrile and (*p*-chlorophenyl)phenylacetonitrile at 8 lb/A; 2-methoxy-4,6-bis-(isopropylamino)-*s*-triazine, 2-methoxy-4-propylamino-*s*-triazine, and 2-methoxy-4-ethylamino-6-isopropylamino-*s*-triazine at 2, 4, and 8 lb/A; and sodium PCP at 15, 20, and 25 lb/A gave poor to fair control. The last 4 herbicides listed resulted in moderate to severe injury to the beans at all rates. Undoubtedly the dry conditions influenced the results. (Dept. of Botany and Plant Pathology, Purdue Univ. Agr. Expt. Sta.).

CIPC plus NPA on ten varieties of soybeans. Smith, P. E. and Bondarenko, D. D. Ten varieties of soybeans were planted in 42-inch rows in a Brookston-Miami silty clay loam at Columbus on June 23, 1958. On June 24, triplicate plots 4 soybean rows wide and 200 feet long were treated overall with a mixture of CIPC plus NPA at 4 plus 2 lb/A in 40 gallons of water. One and one-fourth in. of rain fell within 6 hours after herbicide application. All plots, including the checks, were almost weed-free.

The soybeans in most of the treated plots did not emerge as quickly as the checks and were slightly shorter than the checks at harvest time. The average yield of the treated plots was 3.8 bushels lower than the corresponding variety checks. There was no significant interaction between varieties and treatment. The yield of each variety is given in the following table.

Yields of ten varieties of soybeans treated pre-emergence

	Yield, bu/A				
	Monroe	Blackhawk	Harosoy	Hawkeye	Lincoln
Treated	24.2	25.6	29.4	29.9	32.5
Check	29.6	24.6	31.6	35.5	37.5
Check minus treated	5.4**	—1.0	2.2	5.6**	5.0**

	Clark	H20771	H20833	H21793	H24157	Mean
Treated	32.4	27.7	29.7	28.2	30.3	
Check	37.4	32.5	31.8	33.2	34.1	
Check minus treated	5.0**	4.8**	2.1	5.0**	3.8**	3.8

** Significant at the 1% level.

(The Ohio Agr. Exp. Sta.)

Herbicides on soybeans. Stroube, E. W. and Bondarenko, D. D. Blackhawk soybeans were planted in Hoytville silty clay loam at the Northwest Substation, Hoytville on May 28, 1959 and in Canfield silt loam at Wooster on June 4. Harosoy soybeans were planted in Miami-Brookston silty clay loam at Columbus on June 3. German millet, to simulate annual grasses, was sown in the plots at Hoytville. They had a natural infestation of smartweed and common ragweed. At Columbus the plots were infested by redroot pigweed, lambsquarters, crabgrass and foxtails. Triplicate 4-row plots were band-treated (21-inch band) over the row at Hoytville and Wooster and overall at Columbus, but rates in lb/A are given overall. All herbicides were applied in 40 gpa of water.

Pre-emergence: Amoben (triethylamine salt of 3-amino-2,5-dichlorobenzoic acid) at 1, 2, 3, and 4 (only at 2 and 4 at Columbus); sodium salt of NPA at 2, 4, and 6 (only at 4 at Columbus); CIPC at 6 and 8 (only at 6 at Columbus); mixuture of sodium salt of NPA and CIPC at 2 + 2 and 3 + 3 (only at 2 + 2 at Columbus); and CDAA at 2 and 4 (only at 4 at Columbus).

Cotyledon stage: DNBP at 3 and 6 at Hoytville, 3 and 4 at Columbus and 2 and 4 at Wooster; mixture of sodium salt of NPA and CIPC at 2 + 2 and 3 + 3 (only at 2 + 2 at Hoytville); Amoben at 2 and 4; Atrazine (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine) at 2 (only at Columbus); and amitrol at ¾ and 1 (only at Columbus).

First trifoliate leaf stage at Columbus and 2nd to 3rd trifoliate at Hoytville: DNBP at 2¼ and 3 and alkanolamine salts of 2,4-D at ¼ and ½.

Amoben applied pre-emergence at 3 and 4 lb/A at Hoytville and Wooster gave 90% or more reduction in stand of all weeds except smartweed, which was reduced 75 to 90%. The 1 and 2 lb rates gave 70 to 85% control of all weeds. Amoben pre-emergence at Columbus gave 50 to 70% reduction of weeds. NPA alone and with CIPC pre-emergence at Wooster gave 80% or more reduction of weeds. CIPC at Wooster gave 95% control of grasses, about 50% control of broadleaf weeds. NPA pre-emergence at Hoytville gave 80 to 90% control of all weeds except smartweed, which was reduced 50% or less. At Hoytville NPA plus CIPC at 3+3 lb/A pre-emergence reduced the weed stand 80% or more, at 2+2 lb/A, 60 to 70%; CIPC alone gave unsatisfactory weed control. At Columbus NPA, CIPC and mixtures of the two pre-emergence gave unsatisfactory weed control. CDAA reduced the weed population 80% or more at Wooster, 75% or more at Columbus and 60% or more at Hoytville.

DNBP at the cotyledon stage reduced the weed stand 80% or more at Columbus and Hoytville and 95% or more at Wooster. NPA plus CIPC at 3+3 lb/A reduced the weed population 90% or more at all locations, at 2+2 lb; 70% or more at Wooster and Columbus, and 35 to 50% at Hoytville. Amoben at 2 and 4 lb at cotyledon stage reduced the weed stand 90% or more at Columbus and Wooster and 50 to 80% at Hoytville. At Columbus Atrazine at 2 lb gave 80% or more control, amitrol, 50 to 75% control.

The trifoliate leaf applications of DNBP reduced the stand of broadleaf weeds 75% or more at Columbus and Hoytville, annual grasses 50 to 70% at Columbus and 25% or less at Hoytville. At Hoytville, 2,4-D post-emergence reduced the stand of broadleaf weeds 85% or more but gave no reduction of millet. At Columbus, the 2,4-D at ¼ lb/A reduced the broadleaf weeds 70 to 80% and at ½ lb/A 90% or more. Both rates reduced the grass about 50% at Columbus.

None of the pre-emergence treatments damaged the soybeans. Atrazine at the cotyledon stage at Columbus damaged soybeans slightly but they recovered. Amitrol at the cotyledon stage damaged soybeans somewhat. DNBP at 4 lb/A at coyledon stage at Wooster severely injured soybeans. Slight injury was caused by DNBP at the 2- to 3-trifoliate stage at 2¼ and 3 lb/A at Hoytville and at 3 lb/A at Columbus. At Hoytville and Columbus, 2,4-D at ¼ lb/A post-emergence caused slight injury and at ½ lb/A severe injury. (The Ohio Agr. Exp. Sta.)

SMALL GRAINS

Preplanting incorporation and pre-emergence herbicides on flax. Behrens, R. Pre-planting incorporation treatments of EPTC at 1½ and 3 lb/A and 2,5-dichloro-3-aminobenzoic acid at 2 lb/A were applied to triplicate plots of Waukegan silt loam soil at Rosemount, Minnesota on April 30, 1959. Flax was planted the same day. Pre-emergence applications of 2,5-dichloro-3-aminobenzoic acid at rates of 2 and 6 lb/A were made the following day. Flax stands were reduced 20% by the 3 lb/A rate of EPTC and the 2 lb/A rate of 2,5-dichloro-3-aminobenzoic acid in the soil incorporation treatments. Pre-emergence treatments with 2,5-dichloro-3-aminobenzoic acid at rates of 2 and 6 lb/A reduced flax stands 5 and 35%, respectively. EPTC at the 1½ and 3 lb/A rates reduced annual broadleaf weeds, including *Amaranthus retroflexus, Kochia scoparia, Chenopodium*

album, *Polygonum persicaria*, and *P. convolvulus*, 20 and 70% and annual grass weeds, including *Echinochloa crusgalli* and *Setaria* spp., 65 and 85%, respectively. Both applications of 2,5-dichloro-3-aminobenzoic acid at the 2 lb/A rate reduced annual broadleaf and grass weeds an estimated 75% while the 6 lb/A pre-emergence application gave an estimated weed control of 95%. Undersown alfalfa was not injured by EPTC but was eliminated by all of the 2,5-dichloro-3-aminobenzoic acid treatments. (Contribution from the Department of Agronomy and Plant Genetics, Univ. of Minnesota, St. Paul. Paper No. 4251, Sci. Jour. Series, Minn. Agr. Expt. Sta.)

Reaction of wheat, oats, barley and flax to the diethanol amines and the butyl esters of 4-(2,4-DB) and 4-(MCPB); and CP 1815 (mixture of chlorinated benzoic and cresoxyacetic acids). Brown, D. A. Crops were grown on Assiniboine heavy clay loam. Plots were relatively weed-free with the exception of flax and barley. Applications were made in water at 5 gal/A.

Treatment	oz/A	Yield in bushels per acre			
		Wheat	Oats	Barley	Flax
2,4-DB, butyl ester	12	37.2	63.8	66.3	15.9
	16	33.5	52.3	56.7	17.1
2,4-DB, diethanol amine	16	33.2	71.1	80.7	22.5
	20	32.7	78.1	77.9	13.4
MCPB, butyl ester	12	39.3	85.9	70.8	19.0
	16	32.9	83.1	75.3	18.3
MCPB, diethanol amine	16	34.1	89.9	79.2	17.7
	20	24.3	88.7	71.1	22.7
2-(MCPP), sodium salt	12	34.4	94.6	57.0	21.8
	16	33.8	81.2	78.0	20.8
	20	36.7	90.6	73.2	17.0
CP 1815	3	30.6	88.2	66.0	15.9
	6	31.9	80.3	69.4	21.8
	9	28.3	76.9	65.9	14.8
Hand-weeded check		40.2	88.4	67.2	30.0
Weedy check		38.0	87.1	58.4	16.1

At the rates used, 2,4-DB ester was the only formulation that significantly depressed yields. Obviously treatments had a tendency to suppress yields of wheat and flax. (Experimental Farm, Brandon, Manitoba.)

Responses of oats to residual triazine herbicides in the soil. Buchholtz, K. P. In 1957, simazin, Trietazine (2-chloro-4-ethylamino-6-diethylamino-*s*-triazine), Propazine (2-chloro-4,6-bis(isopropylamino)-*s*-triazine), and Ipazine (2-chloro-4-diethylamino-6-isopropylamino-*s*-triazine) were applied overall as a pre-emergence spray at rates of 1, 2, and 4 lb/A on May 24 to plots planted to corn. Additional plots were treated with CDT and CDAA at 4 lb/A and diuron and 2,4-D at 2 lb/A. A clean, cultivated check and an untreated, uncultivated plot were included in each of the four replicates. The soil was a Miami silt loam. None of the plots, except the check, were cultivated during the summer. After harvest of the corn, the stalks were shredded and the entire area plowed. In the spring of 1958, Beedee oats at 2 bu/A were sown over all the plots on April 11 and Vernal alfalfa was seeded at 10 lb/A on April 14. Quadrats of oats were harvested from each plot when mature. Alfalfa plants were counted in quadrats in each plot on September 26.

In 1958, an additional trial was studied. Simazin, Propazine, Atrazine (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine), Prometone (2-methoxy-4,6-bis(isopropylamino)-*s*-triazine), and G-30026 (2-chloro-4-methylamino-6-isopropylamino-*s*-triazine) were applied overall as pre-emergence sprays at rates of 1, 2, and 4 lb/A on May 14 to plots planted to corn. Clean cultivated, and untreated, uncultivated, check plots were included. None of the plots except the check plots were cultivated during the season. The soil was a Miami silt loam in an area adjacent to that used in 1957. After the corn was harvested, the stalks were shredded and the area plowed. In the spring of 1959, the entire area was seeded with Beedee oats on April 29 using 2 bu/A and with Vernal alfalfa on April 30 using 10 lb/A. When the oats matured, quadrats were harvested from each plot to determine yields.

Material	Rate lb/A	Oat growth index[1]		Oat grain yield lb/A[2]		Alfalfa plants per sq ft
		1958	1959	1958	1959	1958
Simazin	1	9.7	8.3	3280bcd	1650a	21.0a
	2	9.0	9.0	4000a	1790a	19.9a
	4	8.7	5.8	4010a	670bc	19.2a
Trietazine	1	10.0		3000def		23.7a
	2	10.0		3000def		21.6a
	4	9.5		3380bc		20.4a
Propazine	1	10.0	8.0	3190cde	1530a	21.6a
	2	8.7	7.8	2940cde	1310abc	20.6a
	4	6.0	4.5	2700ef	280d	19.1a
Ipazine	1	10.0		3460b		20.3a
	2	9.9		2720ef		18.6a
	4	9.4		2940cde		21.7a
Atrazine	1		8.5		1570a	
	2		8.8		1980a	
	4		2.5		90a	
Prometone	1		7.8		1600a	
	2		7.8		1690a	
	4		2.8		430de	
G-30026	1		8.3		1720a	
	2		8.8		1530a	
	4		4.5		660cd	
CDT	4	10.0		2910de		19.7a
Diuron	2	9.6		3380bc		19.1a
CDAA	4	10.0		2570f		20.7a
2 4-D	2	10.0		2960cde		21.2a
Weedy check	-	10.0	8.0	2990cde	1360ab	20.2a
Clean check	-	10.0	9.5	3120cde	2120a	19.5a

[1] Index 10 - normal growth, 0 - no growth.
[2] Values adjacent to the same letter are not significantly different at the 5% level.

The responses of the oats in the two years were different. In 1958, only plots treated with Propazine applied at 4 lb/A appeared to show a significant yield reduction when compared to the weed-infested check plots. Early in the spring of 1958, oats on plots treated with Propazine at 4 lb/A the previous year showed considerable leaf-tip injury. The injury was present but less pronounced on plots treated with simazin at 4 lb/A. In no case was injury to the alfalfa or reduction in stands observed.

In 1959, the oats on many of the plots showed evidence of residual triazine injury. Plots treated with Propazine and Atrazine at 4 lb/A appeared to be injured most severely. Considerable injury was also present on plots treated with simazin, Prometone and G-30026 at 4 lb/A. No marked symptoms of injury were observed on plots treated with simazin or Atrazine at 2 lb/A the previous year. The oat yields on plots treated with various triazine analogues at 1 and 2 lb/A were not significantly less than the yields on the clean cultivated plots. Yields on plots treated with the 4 lb/A applications were all significantly less. There was evidence that poor control of weeds on certain plots in 1958 reduced the yields of oats in 1959 even though residual injury was not evident.

The differences in degree of residual oat injury in plots treated in 1957 and 1958 may be associated with the weather in the two years. The rainfall in the month after treatment in 1957 was relatively abundant and weed control was excellent. In 1958, a period of three weeks without rain followed treatment. Weed control in 1958 was only fair. Applications of 1 or 2 lb/A of the various triazine analogues did not result in significant damage to the oats or yield reductions in either year. Applications of 4 lb/A gave severe reductions with

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every herbicide in 1959 and with Propazine in 1958. (Department of Agronomy, Univ. of Wisconsin, Madison.)

Soil treatments in the greenhouse with Avadex, Carbyne, and Fenac at seeding time of wild oats, wheat and barley. Corns, Wm. G. A row of 20 seeds of each species including wild oats, Thatcher wheat, Gateway barley and Kharkov winter wheat, was seeded in each flat of sterilized loam soil following each of triplicate treatments for each chemical and rate. Treatments, Aug. 26, 1959, were Avadex (2,3,dichloroallyl diisopropylthiolcarbamate, cis and trans mixture), and Carbyne [4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate] at 0, 1, 2, 4, and 8 lb/A, and Fenac (2,3,6-tri-phenylacetic acid) at 0, 2, 4, 8, and 16 lb/A, sprayed and mixed in the top inch of soil before seeding. Periodic records of survivors, condition and size of shoots for two months were concluded with dry weights of foliage and of roots. Avadex at 1 lb/A allowed good survival and growth of barley, killed wild oats and seriously damaged wheat, especially Thatcher. Carbyne, even at 8 lb/A, had limited effect on wild oats, less effect on wheat and barley, in contrast to trends following its use in our Petri dish tests noted in another report. Fenac at 2 lb/A and higher injured the wheat more than the wild oats, and by a wide margin was most injurious to barley. (Division of Crop Ecology, Dept. of Plant Science, Univ. of Alberta.)

Soil treatments in the field with Avadex, Eptam, and Niagara 5996, at seeding time of wild oats, barley, wheat and flax. Corns, Wm. G. On May 20, 1959, the soil was sprayed, double disced and seeded with 2½ bu/A wild oats, 2 bu/A Parkland barley, 2 bu/A Thatcher wheat, and 40 lb/A Redwing flax in separate duplicate plots for each treatment of Avadex (2,3,dichloroallyl diisopropylthiolcarbamate, cis and trans mixture), and of EPTC (Eptam), at 2, 4, and 6 lb/A, and of Nia. 5996 (2,6-dichlorobenzonitrile) at 1, 2, and 4 lb/A applied in 30 gal/A water. The tables show counted survival numbers and yields as percentage of check:

	Relative percentages of plants on June 11			
	W. oats	Barley	Wheat	Flax
Avadex				
2 lb/A	5	105	101	116
4 lb/A	5	81	62	116
6 lb/A	1	72	67	77
Eptam				
2 lb/A	40	112	86	107
4 lb/A	13	84	69	93
6 lb/A	5	77	29	81
Nia. 5996				
1 lb/A	82	86	106	77
2 lb/A	51	77	73	65
4 lb/A	12	86	40	16

	Final yields as percent of check								
	Avadex, lb/A			Eptam, lb/A			Nia. 5996, lb/A		
	2	4	6	2	4	6	1	2	4
Wild oats (Aug. 11)									
No. of tillers	12	10	1	57	25	8	92	67	18
Dry wt. veg.	15	8	0.3	63	32	13	90	73	23
Barley (Sept 1)									
No. of tillers	104	81	93	101	104	68	101	89	75
Dry wt. veg.	103	94	93	104	104	76	96	87	79
Grain	105	83	85	107	102	75	100	87	76
Wheat (Sept 1)									
No. of tillers	97	71	48	96	79	40	104	99	69
Dry wt. veg.	103	93	66	95	87	51	103	103	85
Grain	107	93	66	99	94	40	98	99	101
Flax (Sept 23)									
No. of tillers	95	91	65	85	76	92	85	63	40
Dry wt. veg.	96	96	92	95	103	113	101	85	59
Grain	94	98	97	88	100	109	97	81	57

Even greater mortality of wild oats could have been expected had they been subject to crop competition. In general, Avadex caused maximum killing of wild oats with minimum effects on the crops. Niagara 5996 was the least satisfactory. (Division of Crop Ecology, Dept. of Plant Science, Univ. of Alberta.)

Foliage sprays of Carbyne on wild oats and on wheat in the field. Corns, Wm. G. Thatcher wheat and wild oats were seeded on May 15, 1959 in separate duplicate plots for each treatment. Rates were 2 bu/A for wheat and 2½ bu for oats. Treatments with 4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate (Carbyne) at 0, ½, 1, and 2 lb/A in 30 gal/A water were (Stage 1) on May 27 when plants had 1 to 1¼ leaves; Stage 2 on June 2, 2 to 3 leaves. Ten marked plants per plot were measured weekly for 5 weeks. Heights expressed as % of check at 5 weeks showed greater effect from Stage 2 treatments:

	Wheat		Wild oats	
	Stage 1	Stage 2	Stage 1	Stage 2
½ lb/A	108	95	67	84
1 lb/A	107	90	50	41
2 lb/A	108	90	40	28

Final yields of wild oats (total dry matter) harvested Aug. 5, wheat (t.d.m. and grain) harvested Sept. 9, and numbers of tillers as % of check were:

	Wheat			Wild oats	
	Tillers	Dry wt	Grain	Tillers	Dry wt
½ lb/A, Stage 1:	94	107	112	94	102
½ lb/A, Stage 2:	88	89	88	98	76
1 lb/A, Stage 1:	93	103	101	51	57
1 lb/A, Stage 2:	96	98	95	76	63
2 lb/A, Stage 1:	117	110	98	56	62
2 lb/A, Stage 2:	101	101	97	36	27

(Division of Crop Ecology, Dept. of Plant Science, University of Alberta.)

Foliage sprays of Carbyne on wild oats in wheat in the field. Corns, Wm. G. On May 15, 1959, triplicate plots were seeded with 2 bu/A Thatcher wheat and cross-seeded with 2½ bu/A wild oats in 6" rows. Randomized sprays with 4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate at 0, ¼, ½, and 1 lb/A in 5 and 30 gal/A water were applied May 27 (Stage 1), 1 to 1¼ leaves, wheat 98 mm, oats 42 mm tall, and on June 2 (Stage 2) 2 to 3 leaves, wheat 142 mm, oats 68 mm tall. Average heights of ten plants per plot 5 weeks after spraying, shown as percent of check, indicate more stunting of wild oats by lower gallonage at either stage:

	¼ lb/A		½ lb/A		1 lb/A	
	5 gal	30 gal	5 gal	30 gal	5 gal	30 gal
Wheat						
Stage 1	96	95	99	104	91	98
Stage 2	96	99	94	95	76	99
Oats						
Stage 1	62	108	44	59	46	84
Stage 2	58	93	40	76	42	35

Final yields of wild oats (total dry matter) harvested Aug. 6, wheat (t.d.m. and grain) harvested Sept. 10, and numbers of tillers as percent of check were:

	Stage 1			Stage 2		
	Tillers	T.D.M.	Grain	Tillers	T.D.M.	Grain
Wheat						
¼ lb/ 5 gal	111	129	115	106	139	151
¼ lb/30 gal	111	119	115	112	111	113
½ lb/ 5 gal	116	131	144	113	135	142
½ lb/30 gal	106	123	131	117	132	134
1 lb/ 5 gal	110	132	149	128	147	163
1 lb/30 gal	122	145	160	113	147	136
Wild oats						
¼ lb/ 5 gal	75	44	....	76	43	....
¼ lb/30 gal	96	91	....	92	76	....
½ lb/ 5 gal	34	22	....	34	14	....
½ lb/30 gal	65	54	....	72	49	....
1 lb/ 5 gal	49	37	....	26	13	....
1 lb/30 gal	51	37	....	30	15	....

In general, low volume at all rates was the more injurious to wild oats at either stage, and in most cases there was corresponding superiority of wheat yield. Maximum wheat yield and minimum wild oat yield resulted from 1 lb. Carbyne in 5 gal/A at Stage 2. (Division of Crop Ecology, Dept. of Plant Science, Univ. of Alberta.)

Carbyne applied to wheat and barley at various rates, dates and volumes of water for the control of wild oats. Friesen, H. A. Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) was sprayed on Thatcher wheat heavily infested with wild oats, at two growth stages of the wild oats: 1, the 1½-leaf stage, and 2, the 4-leaf stage; treatment rates were 0, ¼, ½ and 1 lb/A in two volumes of water, 6 and 30 gal/A. Eight to 10 days after spraying all Carbyne treatments tended to cause the wild oats to turn bluish in color with a decided thickening or clubbing of the leaves. These effects became pronounced to the point of necrosis during the following 2 to 3 weeks, especially where the two heaviest rates were used in the low volume of water. At the late boot stage of the wheat new leaf and stem initials of wild oats were in evidence. Plant counts showed that at least 70 percent of the treated wild oats recovered. Weekly height measurements showed wide variations in the rate of recovery following the different treatments. Development of the wild oats plants was measured by their dry weight, taken at maturity of the grain, and by the yield wheat. Carbyne at ½ and 1 lb/A in 6 gal/A of water applied at 1½-leaf stage resulted in the greatest reduction in dry weight of wild oats, about 25 percent, and the greatest increase in yield of wheat, about 20 percent. At the 2 to 3-leaf stage the wild oats suppression was slightly less and yield increases of wheat were somewhat smaller. This herbicide used at ¼ lb/A rate at either growth stage resulted in only a very temporary checking of the wild oats but tended to show increased wheat yield at the early date. Increasing the volume of water to 30 gal/A markedly reduced the effectiveness of the herbicide in suppressing the growth of wild oats. This resulted in lowered yield of wheat, particularly at the early stage of application.

Extremely cool, cloudy and wet weather throughout the months of August and September prolonged maturity of the wheat by at least 3 weeks. The occurrence of frost on September 6 prevented true maturation of the wheat. This much extended growth period worked to the advantage of the wild oats, allowing them to effect a greater recovery.

A similar trial was conducted on Parkland barley. The results followed similar trends to those described for wheat. However, the wild oats infestation was quite variable and the results were not as clear cut. Since the barley matured 5 weeks earlier than the wheat, wild oats suppression was more pronounced. (Contributed by the Experimental Farm, Lacombe, Alberta).

Field scale trial with Carbyne to control wild oats in wheat. Friesen, H. A. On June 18, 1959, a 2-acre field of Thatcher wheat, undersown with alfalfa-brome, was sprayed with a mixture of Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) at ½ lb/A and the diethanolamine salt of MCPA at ¼ lb/A in 5 gal/A of water. The wild oats were mostly in the 1½-leaf stage, the wheat was in the 2 to 3-leaf stage and the alfalfa was in the cotyledon stage at the time of spraying. One-half of the field had ammonium phosphate, 11-48-0, at 50 lb/A drilled in with the seed. An untreated strip was left on the fertilized portion of the field. Within 8-10 days the treated wild oats developed club-like leaves, deep bluish in color. Many became necrotic and withered away. On July 18 it was observed that the majority of the plants were not dead but were sending up new leaf and stem initials. By July 30 the wheat and untreated wild oats were fully headed, the treated wild oats were weak, spindly and very much retarded. The late tillers on the treated wheat were visibly retarded. On August 14 wild oats heads began appearing in the treated unfertilized part and 4 to 6 days later on the fertilized part. Very cool, wet weather delayed maturity of the wheat by 3 to 4 weeks during which time the wild oats effected a steady recovery, especially on the unfertilized area. Counts revealed little reduction in the number of wild oats plants but dry weight of wild oats was drastically reduced. The yield of wheat on the fertilized part was increased 25 per cent as a result of spraying. Due to later maturity it suffered more frost injury than the untreated. The undersown alfalfa and bromegrass suffered no apparent injury. (Contributed by the Experimental Farm, Lacombe, Alberta)

Field scale trials with Avadex for the control of wild oats. Friesen, H. A. Trial I. On April 28, 1958, field strips, two acres in size, were sprayed with 2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture, (Avadex) at 0.75, 1.5, 2.0, 2.5, and 3.0 lb/A at Innisfail, Alberta. After treatment one-half of each strip was disced once while the other one-half was disced twice. Plant counts on June 2, five weeks later, showed 80 to 85% reductions in numbers of wild oats as a result of the 2.0, 2.5 and 3.0 lb/A applications. The other treatments were not sampled. On June 5 the entire area was thoroughly cultivated and seeded to Olli barley. This treatment effectively controlled the wild oats on both the treated and untreated strips. On the 2.5 and 3.0 lb/A treatments, thinning of the barley stand was in evidence. Yields indicated no loss of barley yield as a result of this thinning. Discing twice showed no advantage over discing only once. Trial II. Avadex was sprayed at 1, 2, and 3 lb/A and incorporated with a one-way disc at Acme, Alberta on May 28. On May 20 the entire area was seeded to flax. Plant counts showed that the number of wild oats had been reduced by some 80 percent as a result of all but the 1 lb/A treatment while the number of flax plants was not affected. The dry weight of wild oats was reduced 98, 82 and 73 percent as a result of Avadex at 3, 2 and 1 lb/A, respectively. Treatment with Avadex at 2 and 3 lb/A increased the flax yield by approximately 300 lb/A. (Contributed by the Experimental Farm Lacombe, Alberta.)

The reaction of three varieties of barley to Carbyne. Friesen, H. A. Gateway, Husky, and Olli barley were sprayed with Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) at ½ and 2 lb/A in 5 gal/A of water at the 1½ to 2-leaf and 3 to 4-leaf growth stages of the barley. The plots were kept hand-weeded throughout the season. Carbyne at ½ lb/A applied at the 1½ to 2-leaf stage of the barley did not affect the yield of any one of the varieties. At the 3 to 4-leaf stage the yields of Husky and Olli were reduced by 15 and 30 percent, respectively, by Carbyne at ½ lb/A. Barley maturity was delayed by 4 days as a result of treatment at either stage. Carbyne sprayed at 2 lb/A at the 1½ to 2-leaf stage reduced the yields of Gateway and Husky by 15 percent, and at the 3 to 4-leaf stage the yield of all varieties was reduced by at least 60 percent. Maturity was delayed 8 to 10 days by 2 lb/A. (Contributed by the Experimental Farm, Lacombe, Alberta.)

EPTC (Eptam) and CIPC applied in the fall for the control of wild oats. Friesen, H. A. On October 14, 1958, Eptam at 4 and 8 lb/A and CIPC at 6 and 12 lb/A were sprayed on stubble known to be heavily infested with wild oats. The stubble was one-way disced prior to spraying and again directly after spraying. On May 13, 1959, the treated strips were cross-seeded to Vantage barley and Redwing flax. The effect of the treatments on the number of plants and weight of both the wild oats plants and the flax seed, as well as the yield of barley, are given in the table below:

XUM

Treatment	Rate lb/A	Wild oats plants sq yd	Wt. of w. oats lb/A	Flax plants sq yd	Flax seed lb/A	Barley lb/A
Eptam	4	73	990	158	503	1150
Check	—	167	1790	160	247	570
Eptam	8	12	340	143	731	1280
CIPC	12	39	770	79	418	760
Check	—	520	2890	157	109	470
CIPC	6	139	2360	102	213	790

(Contributed by the Experimental Farm, Lacombe, Alberta)

The reaction of three varieties of wheat to Carbyne. Friesen, H. A. Thatcher, Saunders, and Selkirk wheat were sprayed with Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) at ½ and 2 lb/A in 5 gal/A of water, at two growth stages of the wheat, 1, 1½ to 2-leaf and 2, 4-leaf stage. The plots were kept hand-weeded throughout the season. Carbyne at ½ lb/A applied at 1½ to 2-leaf stage did not affect the yield of Thatcher and Saunders but reduced the yield of Selkirk by nearly 10 percent. At the 4-leaf stage this rate reduced the yields of Thatcher, Saunders, and Selkirk by 25, 18, and 10 percent, respectively. Carbyne at 2 lb/A reduced the yields of all varieties by at least 45 percent. The descending order of tolerance to this dosage at either growth stage was Saunders, Thatcher, and Selkirk. (Contributed by the Experimental Farm, Lacombe, Alberta.)

The reaction of three varieties of flax to Carbyne. Friesen, H. A. Redwing, Redwood, and Rocket flax were sprayed with Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) at ½ and 2 lb/A in 5 gal/A of water when the flax had 1, 3 true leaves, and 2, 8 true leaves. The plots were kept hand weeded throughout the season. Redwing was the most tolerant variety followed by Rocket and Redwood. The yields are given expressed as a percentage of their checks.

Variety	Rate lb/A	Stage of growth	Yield as pct. of check
Redwing	½	1	118.0
	2	1	88.9
	½	2	95.4
	2	2	23.6
Rocket	½	1	92.0
	2	1	38.7
	½	2	62.5
	2	2	17.6
Redwood	½	1	71.0
	2	1	36.1
	½	2	50.7
	2	2	12.1

(Contributed by the Experimental Farm, Lacombe, Alberta.)

Field trials with Carbyne [4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate] on the control of wild oats in wheat, barley, and flax. Gull, P. W.; Zeisig, Jr., H. C.; Epperly, Jean; Pullen, Joe; Dubrovin K.; Jones, Bill; and Eck, Joe. Several factorial experiments were run in the United States and Canada wherein rates, time of application, spray volume, and formulation were compared. Other experiments were designed on varieties of wheat and barley, reactions to Carbyne at different rates and times of application. The compatibility of Carbyne with an amine of MCPA was studied. Nozzle types were also investigated. It was found that spray volume was not an effective factor when different volumes were obtained by holding all other factors constant except speed. No difference in activity was apparent between the several emulsifiable concentrates.

Rates per acre and time of application proved to be the only factors significantly affecting the activity of Carbyne. ½ lb/A was superior to ¼ lb/A but not quite as effective as 1 lb/A for the control of wild oats. Stunting was apparent on wheat with 1 lb/A but not evident with ½ lb/A. Flax was rather severely stunted with 1 lb/A and slightly with ½ lb/A. However, with heavy wild oats competition both rates gave significant yield increases. Application timing proved to be highly effective in controlling the activity of Carbyne on wild oats. The most effective morphological stage of wild oat development was between the 1½ to 2¼ leaf stage or 4 to 9 days after emergence when the plants were developing normally. Application dates earlier or later than this range gave increasingly less control with time.

There appeared to be no interaction between an amine of MCPA and Carbyne in the control of wild oats and broad-leaf weeds nor injury to the crops. Spray nozzle type affected the activity of Carbyne. Hollow cone nozzles were about twice as effective as the fan type nozzle and solid cone nozzles were intermediate. Yield increases of 5 to 6 bushels of wheat, 6 to 15 bushels of barley and 2 to 6 bushels of flax were obtained where medium to heavy infestations of wild oats were present. (Contribution of Spencer Chemical Co.)

Avadex for wild oat control, 1959. Selleck, G. W. Farm spraying equipment was used to apply Avadex (2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture) on two-acre plots at rates which varied between 0.8 and 3.0 lb/A in 14 gal/A water on silty clay loam near Saskatoon, May 8, loam soil near Spalding, May 13, and on silty clay loam soil near Naicam, Sask., May 15. Half of the plots were disked once and the other half disked twice immediately after spraying. The plots near Saskatoon and Spalding were seeded to barley 21 days and 1 day after spraying, respectively, and the Naicam plots were seeded to flax 4 days after spraying. The percent of reduction in stand of wild oats at various rates is presented in the table.

	Hannchen barley on smf. at Saskatoon		Montcalm barley on stubble at Spalding		Norland flax on smf. at Naicam	
Rate (lb/A)	Two diskings	One disking	Two diskings	One disking	Two diskings	One disking
0.8	90	75	—	—	—	—
1.0	—	—	60	30	75	50
1.2	95	75	—	—	—	—
1.5	95	90	95	40	98	95
2.0	95	90	95	50	98	98
2.5	95	90	95	50	98	98
3.0	—	—	99	95	98	98

Two diskings of the treated plots appeared to provide better wild oat control than one disking, particularly on stubble. At Spalding, the treated barley plots outyielded the untreated checks by several times. Yield data were not taken on the other plots. Avadex was applied near Spalding with a farm sprayer at a rate of 1.5 lb/A in 4.5 gal of water. The field was cultivated, harrowed, sprayed, harrowed, and seeded to Thatcher wheat in that order, on May 15. Wild oats were controlled 99 percent and the undamaged wheat yielded more than 40 bu/A. (Contribution No. 256 from the Dept. of Plant Ecology, Univ. of Saskatchewan, with financial assistance from the Monsanto Chemical Co. Ltd.)

EPTC and Avadex for wild oat control in various crops, 1959. Selleck, G. W. Pre-seeding applications of EPTC and Avadex (2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture) were applied May 13

with a variable rate sprayer, to a natural infestation of wild oats on loam soil near Spalding, Sask. The herbicides were applied on stubble, at rates which varied between 6 lb/A and 0.4 lb/A in 16 gal of water on quadruplicated, 15x200 ft plots. Half of the plots were disked once and the other half disked twice the same day and were sown to Montcalm barley, Norland flax, Argentine rapeseed and Thatcher wheat the following day. The percentage control (reduction in stand) of wild oats and crops are listed in the following table. The data are presented in fractions, the numerator representing the rate (lb/A) and the denominator the resulting percentage control. The percentages for wild oat control represent mean values for 8 plots.

Crop or weed	EPTC						Avadex							
	One disking			Two diskings			One disking				Two diskings			
Wild oats	2.9 / 95	1.5 / 90	1.3 / 75	2.7 / 95	2.3 / 90	1.6 / 75	2.8 / 98	1.7 / 95	1.6 / 90	1.5 / 75	2.2 / 98	1.3 / 95	0.7 / 85	0.6 / 75
Barley	4.4 / 50	3.8 / 25		4.6 / 75	3.2 / 50	2.8 / 75	4.0 / 25				6.0 / 0			
Flax	6.0 / 0			6.0 / 0			4.0 / 25				6.0 / 0			
Rapeseed	6.0 / 0			4.1 / 95	2.4 / 50	1.0 / 25	4.2 / delayed 2 days				6.0 / 0			
Wheat	4.4 / 75	3.0 / 50	1.8 / 25	3.6 / 95	3.3 / 80	2.3 / 40	4.0 / 75	3.8 / 50	2.5 / 25	—	3.7 / 80	3.1 / 50	2.3 / 25	

The kind of crop had no significant effect on the efficiency of the herbicides for wild oat control. Two incorporations of the herbicide, however (as compared with one), appeared to be more effective. (Contribution No. 253 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Monsanto Chemical Company.)

Carbyne for wild oat control in grain crops, 1959. Selleck, G. W. Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) was applied with a logarithmic sprayer to duplicated, 15x200 ft plots at a maximum rate of 2 lb/A on silty clay loam soil near Saskatoon. The plots were established on natural infestations of wild oats and seeded to various crops on May 1. Montcalm barley was sprayed with Carbyne May 18 in 15 and 30 gal/A water when wild oats had 1½ to 1¾ leaves and barley 1 leaf. All other applications were made in 15 gal/A water. Applications were made May 21 when plants were in the following stages: Norland flax 2 seedling leaves, wild oats 1¾ to 2 leaves, Argentine rapeseed 2 seedling leaves, Fortune oats, Serkirk wheat, and Montcalm barley 1¼ to 1½ leaves. Plots were sprayed May 29 when the plants were in the following stages: Flax 8 leaves, 1 in. tall; wild oats 2 to 2¾ leaves; wheat 2½ leaves, and barley 2¾ leaves. Plots were sprayed June 5 when barley had 3 leaves and wild oats 2¾ to 4 leaves. Rapeseed and flax were sprayed June 16 when they were 4 in. tall and the wild oats in the 4-leaf stage. Due to an extremely dry season, crop stands were thin and short. The stand reductions of wild oats and crop plants are presented as a fraction, the numerator representing the rate of application (lb/A) and the denominator the resulting percentage control. None of the crops were affected at the 2 lb/A rate of Carbyne, with the exception of oats, which were damaged as follows: $\frac{0.9,\ 0.6}{90\quad 75}$. The volume of water which was applied appeared to have no effect on the degree of crop damage or wild oat control. May 18 applications on 4 plots gave no better than 75% control of wild oats. May 21 applications provided inadequate wild oat control in 3 out of 9 plots, with control being $\frac{1.2\ \ 1.0}{90\quad 75}$ in the other 6. Control was $\frac{1.1,\ 1.0,\ 0.8}{95\quad 90\quad 75}$ in both plots which were treated June 5. Treatments on May 29 gave satisfactory control in 4 out of 9 plots as follows: $\frac{1.5,\ 1.2}{90\quad 75}$. June 16 treatments had little effect. The kind of crop had no significant effect on the efficiency of the herbicide for wild oat control. (Contribution No. 255 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agr. Research Foundation.)

The effect of various herbicides on weeds in wheat, 1959. Selleck, G. W. Mixed butyl esters of 2,4-D, a butoxyethanol ester of 2,4-D (ACP L-129), invert emulsion of the butoxyethanol ester of 2,4-D (ACP M-502) and the butyl ester of MCPA were applied June 15 with a variable rate sprayer at rates ranging from 8 lb/A to 0.2 lb/A. Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate) and 2-(NCPP) were applied at a maximum rate of 6 lb/A. The herbicides were applied in 34 gal/A water in duplicated, 15x135 ft plots on silty clay loam soil near Saskatoon. At the date of spraying, weeds ranged from 1 to 4 in. high and the Thatcher wheat was in the 4-leaf stage. Degree of weed control (where 10=complete kill and 7=satisfactory control) of crop and weeds are listed below in fractions, with the numerator representing the rate (lb/A) and the denominator the resulting control.

Herbicide	Thatcher wheat	*Polygonum convolvulus*			*Chenopodium album*			*Thlaspi arvense*			*Salsola pestifer*		
2,4-D, butoxyethanol ester	8.0 / 0	3.7 / 10	1.9 / 7	1.4 / 5	1.0 / 10	0.3 / 7	—	2.9 / 10	0.3 / 7	—	2.8 / 10	0.2 / 7	—
2,4-D invert emulsion, butoxyethanol ester	8.0 / 0	5.0 / 10	3.0 / 7	2.1 / 5	3.5 / 10	0.6 / 7	0.3 / 5	5.0 / 10	0.4 / 7	0.2 / 5	3.7 / 10	0.3 / 7	0.2 / 6
2,4-D mixed butyl esters	5.5 / 3	4.0 / 10	1.9 / 7	0.6 / 5	2.9 / 10	0.4 / 7	0.3 / 5	2.5 / 10	0.25 / 7	—	2.7 / 10	0.2 / 7	—
2-(MCPP)	6.0 / 0	—	4.3 / 7	2.2 / 5	3.7 / 10	1.6 / 7	—	—	1.1 / 7	—	2.8 / 10	1.2 / 7	—
Carbyne	4.0 / 5	2.2 / 3	1.3 / 1	—	—	6.0 / 5	—	—	6.0 / 0	—	—	6.0 / 5	— — 6.0 / 0
MCPA, butyl ester	8.0 / 0	6.0 / 10	3.4 / 7	—	2.3 / 10	0.25 / 7	0.2 / 5	4.1 / 10	0.2 / 7	—	4.1 / 10	1.0 / 7	0.2 / 5

The relatively heavy rates required for control of weeds may be attributed to low soil moisture and slow growing conditions. (Contribution No. 260 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from Amchem Products Inc.)

The effect of various herbicides on seedling legumes, 1959. Selleck, G. W., and Goplen, B. P. Seedling stands of legumes which varied in height from 2 to 5 in. were treated with several herbicides with a variable rate sprayer on silty clay loam soil at Saskatoon, July 14. Rates ranged from 8 lb/A to 0.2 lb/A for all herbicides except neburon which was applied between 16 lb/A and 0.5 lb/A. The herbicides were applied in 34 gal/A of water on duplicated, randomized 15 x 135 ft plots. The degree of damage to stands of forage seedlings is listed in the table. The data are presented as fractions, the numerator representing the rate (lb/A) and the denominator representing visual estimates of the injury Sept. 15, where 7 = satisfactory control and 10 = complete kill. A reading of 3 is considered to be the maximum allowable damage for safe application to the legumes.

XUM

Crop	MCPA butyl ester		2,4-D mixed amines		Na salt 4-(MCPB)		Na salt 4-(2,4-DB)		MCPA mixed amines		MCPA-2,4-DB mix	
Red clover	—	—	3.5 / 10	1.1 / 5	—	—	—	—	—	—	—	—
	4.4 / 3		0.9 / 3		8.0 / 3		8.0 / 3		8.0 / 3		8.0 / 3	
Sweet-clover	1.3 / 10	0.7 / 5	1.4 / 10	0.5 / 5	4.7 / 10	1.1 / 5	4.9 / 10	1.1 / 5	2.3 / 10	1.1 / 5	3.4 / 10	1.1 / 5
	0.5 / 3		0.3 / 3		0.9 / 3		0.4 / 3		0.8 / 3		0.6 / 3	
Alfalfa	1.4 / 10	0.7 / 5	2.3 / 10	1.7 / 5	—	—	—	—	3.5 / 10	1.1 / 5	7.0 / 10	3.5 / 5
	0.5 / 3		1.1 / 3		8.0 / 3		8.0 / 3		0.9 / 3		1.8 / 3	
Alsike clover	1.8 / 10	0.8 / 5	3.4 / 10	1.8 / 5	—	—	—	—	4.9 / 10	2.1 / 5	—	7.5 / 5
	0.6 / 3		1.3 / 3		8.0 / 3		8.0 / 3		1.1 / 3		2.5 / 3	
White clover	2.9 / 10	1.3 / 5	5.5 / 10	2.5 / 5	—	—	—	—	4.9 / 10	2.1 / 5	—	—
	0.8 / 3		1.3 / 3		8.0 / 3		8.0 / 3		1.0 / 3		8.0 / 3	
Birds-foot	1.0 / 10	0.6 / 5	3.5 / 10	1.1 / 5	4.1 / 10	1.6 / 5	6.7 / 10	2.9 / 5	2.5 / 10	1.3 / 5	4.9 / 10	2.0 / 5
tre-foil	0.4 / 3		0.8 / 3		1.0 / 3		1.4 / 3		0.9 / 3		0.8 / 3	

Neburon had no injurious effects on any of the forage seedlings at rates below 12 lb/A and no significant damage to grass seedlings was visible at the highest rates used of any of the herbicides. (Contribution No. 273 from the Dept. of Plant Ecology, Univ. of Saskatchewan, and the Forage Crops Section, Canada Agr. Res. Stn., Saskatoon, with financial assistance from the Sask. Agr. Research Foundation).

Control of downy brome in winter wheat in western Nebraska. Wicks, Gail A. and Fenster, Charles R. 4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate (Carbyne or S-847) at 4 rates (¼, ½, 1, 1 + 0.1% wetting agent, 1 + 0.5% wetting agent, and 2 lb/A) was applied in 20 gpa spray solution on winter wheat at two locations (Hemingford, Nebraska—October 15, 1958 and North Platte, Nebraska—October 31, 1958). The *Bromus tectorum* at spraying time was in the 2-leaf stage at Hemingford and was in the well tillered stage at North Platte. Visual observations of control of *Bromus tectorum* and the damage to wheat were made the following spring and summer. Results were as follows: poor control resulted from rates below 2 lb/A and only poor to fair control at the 2 lb/A rate. Addition of the wetting agent (diethylene glycol abietate) did not improve effectiveness of the chemical. Injury to winter wheat appeared at the 1 lb/A rate. (Contributed by Univ. of Nebraska Exp. Sta., Box Butte and North Platte, Nebraska, and Nebraska Department of Agriculture & Inspection, Division of Noxious Weeds, North Platte.

BIENNIAL AND PERENNIAL LEGUMES

Evaluation of 2,5-dichloro-3-aminobenzoic acid in preplanting incorporation and pre-emergence applications to legumes. Behrens, R. Preplanting incorporation and and pre-emergence applications of 2,5-dichloro-3-aminobenzoic acid at 2, 4, and 6 lb/A and 1, 2, and 4 lb/A respectively, were applied to a Waukegan silt loam soil in triplicated plots on May 27, 1959 at Rosemount, Minnesota. Alfalfa, birdsfoot trefoil, red clover, alsike clover, and yellow sweetclover were seeded in rows across these plots after the incorporation treatments but before the pre-emergence treatments. Control of natural stands of *Echinochloa crusgalli*, *Amaranthus retroflexus*, *Polygonum persicaria* and *Setaria* spp. was considered excellent for all applications. Preplanting incorporation appeared to be slightly less effective (an estimated 83% kill of weeds) while pre-emergence applications killed an estimated 95% of the weeds when both were applied at 2 lb/A. Preplanting incorporation rates of 2 lb/A reduced stands of alfalfa, red clover, birdsfoot trefoil, alsike clover and sweetclover an estimated 87, 98, 78, 38, and 8%, respectively, and pre-emergence applications of 1 lb/A reduced them an estimated 85, 98, 62, 37, and 10%, respectively. A 1 lb/A pre-emergence application appeared to be as phytotoxic as a 2 lb/A preplanting treatment. Alfalfa and red clover were very sensitive to 2,5-dichloro-3-aminobenzoic acid. Birdsfoot trefoil and alsike clover appeared to have some tolerance to this herbicide, while sweetclover was very tolerant. Stand reductions of sweetclover were estimated at no more than 25% even at the highest application rates. Later in the season, the stands of birdsfoot trefoil and alsike clover appeared normal at the 1 and 2 lb/A rates. Red clover and alfalfa showed little recovery. A significant degree of weed control was evident for both treatment at all rates throughout the growing season. (Contribution from the Department of Agronomy and Plant Genetics, Univ. of Minnesota, St. Paul. Paper No. 4250, Sci. Jour. Series, Minn, Agr. Expt. Sta.)

Effect of herbicides on alfalfa and sweetclover seedlings. Brown, D. A. Treatments were applied to a crop of wheat underseeded with legumes in 1958 as follows: diethanolamines of 2,4-D and MCPA at 4, 6, and 8 oz/A; the sodium salts and butyl esters of 2,4-DB and MCPB at 16, 20 and 24 oz/A. Final appraisal of legume plant survival was made in October 1958. Hay yields were taken in July 1959. Not in a single group did the checks out-yield the treated plots in alfalfa but in sweetclover the untreated checks consistently out-yielded treated plots by from .5 to one ton per acre in all the esters of 2,4-DB and MCPB and in the 2,4-D amine but in the MCPA amine and sodium salts of 2,4-DB and MCPB, check plots did not significantly out-yield treated plots. While the percentage stand at the end of the 1958 growing season reflected clearly the tolerance of the legumes to various formulations, the yield trend in 1959 showed but a slight correlation with the stand of crop as recorded the previous autumn. It was obvious that plants in thin stands, especially of sweetclover, developed in a widespread vigorous fashion and this narrowed the correlation between stand and yield. After twelve years of experiments it has been found that susceptible weeds can be controlled in seedling stands of alfalfa without measurable damage to the crop. Sweetclover is much more sensitive and is generally thinned at rates necessary to control prevailing susceptible weeds. At rates used the butyric acid formulations were not superior to the acetic acid formulations. (Experimental Research Farm, Brandon, Manitoba.)

Formulations of phenoxyacetic and phenoxybutyric acids on legumes assessed the year following spraying. Friesen, H. A. In 1958, sodium salt and butyl ester formulations of 4-(2,4-DB) and 4-(MCPB) at 0, 16, 20, and 24 oz/A, and mixed amines of 2,4-D and the diethanolamine of MCPA at 0, 4, 6, and 8 oz/A were applied as water sprays to seedling alfalfa, sweetclover, alsike clover and red clover. The legumes had 3 to 5 true leaves when treated. Seedings were made with and without a companion crop of oats seeded at 1 bu/A. A split-plot design was used.

Alfalfa. In 1958 all treatments resulted in excellent kills of the rather light infestation of annual weeds.

While the alfalfa treated with the ester of 4-(2,4-DB) showed to best advantage none of the treatments appeared to suppress the stand and vigor of the plants unduly. In 1959, alfalfa, seeded alone, yielded 3500 lb/A, which was 600 lb/A more than the mean yield of the untreated alfalfa seeded with the companion crop of oats. While the plots treated with the ester of 4-(2,4-DB) gave the highest forage yield, the mean yield of all treated plots was 400 lb/A higher than the mean for the untreated checks, where no companion crop was used. Where the companion crop was used, there was no difference between the mean yields of the treated and untreated alfalfa plots.

Sweetclover. The butyl ester of 4-(2,4-DB) and 4-(MCPB) resulted in very severe losses of stand and yield of sweetclover in 1958. This effect was evidenced again in 1959 when the mean yield of these treated plots was 3400 lb/A as compared with the mean of untreated sweetclover of 4800 lb/A. The diethanolamine of MCPA treatments were outstanding, notably at the 4 and 6 oz/A rates, in that they gave satisfactory weed control and increased the yield of sweetclover by 800 lb/A over the untreated checks. The other treatments did not affect the sweetclover yield in 1959. Sweetclover seeded with the companion crop of oats averaged 1000 lb/A less forage (dry weight) than where seeding was done without the companion crop.

Red clover. While the pattern of yields of treated and untreated red clover tended to follow that of sweetclover the differences were not quite as striking. The diethanolamine of MCPA was the outstanding treatment based on yield of forage. It exceeded the mean of untreated checks by nearly 1000 lb/A. The other treatments yielded only slightly more than the untreated red clover, except the plots treated with the butyl ester of 4-(2,4-DB) which yielded 300 lb/A less. Seeding with a companion crop reduced the mean forage yield on the untreated plots by 400 lb/A.

Alsike clover. None of treatments resulted in marked yield increases of alsike in 1959. All treatments increased the yield by 300 to 500 lb/A, except the butyl ester of 4-(2,4-DB). This treatment yielded 500 lb/A less than the mean yield of the untreated check. Seeding with the companion crop of oats gave higher yields than seeding alside alone in this test. (Contributed by the Experimental Farm, Lacombe, Alberta.)

Effect of pre-emergence and post-emergence herbicides for weed control in alfalfa sown in spring and fall. Louderback, L. T., Freeman, J. F., and Taylor, T. H. Alfalfa (Atlantic variety) at 12 lb/A was seeded in adequately limed and fertilized Maury slit loam soil, in quadruplicated plots September 3, 1958 on one set of blocks and April 7, 1959, on another set. Treatments were: EPTC at 3, 6, and 9 lb/A applied and disked in preplanting, and the same rates surface applied post-planting; 4-(2,4-DB) as mixed esters at 1 lb/A, dalapon 3 lb/A, and a mixture of 4-(2,4-DB) plus dalapon at 1 and 3 lb/A, applied 10-14 days after emergence, and an untreated check. Due to dry soil conditions prevailing at seeding time, sprinkler irrigation was used September 13, to encourage germination in the fall-seeded blocks. Considerable heaving of alfalfa occurred during the severe winter of 1958-59 as there was little snow cover. Heaving was most severe where the stand of weeds was the lightest. Good moisture conditions favored the spring-seeded blocks. Principal weeds in the fall-seeded blocks were chickweed and henbit, and in the spring-seeded blocks, chickweed, henbit, crabgrass, and oxalis, with lambsquarters and smartweed in some areas. The following data were obtained: alfalfa and weed stands from permanent quadrats, 4 and 5 weeks, respectively, after emergence in fall- and spring-seeded blocks; alfalfa stands again in the spring in the fall-seeded blocks; size of alfalfa seedlings based on weight of above-ground growth of 50 plants selected at random in each plot; yield of hay at each of 4 cuttings in fall-seeded blocks, and at 2 cuttings in spring-seeded blocks; and the percentage of weeds contained in the hay.

In the fall-treated blocks, where the untreated check had 42 alfalfa seedlings and 62 weeds per square foot of area and the dry weight of 50 seedling plants was 5 grams, none of the EPTC pre-emergence treatments resulted in significant increases in the stand of alfalfa, whereas post-emergence treatments of 4-(2,4-DB) and dalapon or combination of both herbicides resulted in highly significant increases in stands. Size of seedling alfalfa was not reduced significantly as a result of EPTC at 3, 6 and 9 lb/A surface-applied or in 3 lb/A incorporated, preplanting. Highly significant reductions in size resulted from higher rates of EPTC incorporated, preplanting, and from all post-emergence treatments. Highly significant reductions in number of weeds resulted from all herbicide treatments except at 3 lb/A surface-applied, post-planting, and there significant reduction occurred.

In spring-treated blocks where untreated checks had 34 alfalfa seedlings and 41 weeds/sq ft, and the dry weight of 50 seedling plants was 33 grams, none of the herbicide treatments resulted in significant differences in alfalfa stands. Size of alfalfa seedlings was significantly increased as a result of EPTC at all rates surface-applied and at 3 lb/A incorporated, preplanting. Other treatments did not result in significant differences in size of alfalfa seedlings. Significant reductions in the number of weeds resulted from all pre-emergence herbicide treatments except EPTC at 3 lb/A surface-applied. Of the post-emergence herbicides only the mixture of 4-(2,4-DB) plus dalapon at 1 plus 3 lb/A resulted in significant reductions, this reduction being highly significant.

On the fall-seeded blocks yield of hay the following summer, was greatest in the untreated check and EPTC at 3 lb/A surface applied, where winter weeds had provided adequate protection against loss of alfalfa stands due to winter heaving. However there were less spring and summer weeds produced in the untreated check, than in any treated plots. In the check plot, yield from 4 cuttings was 7740 lb/A with less than 2% weeds. On the herbicide-treated plots where winter weeds were partially or entirely controlled and alfalfa weakened by the severe winter, stand losses varied from 32 to 92%, permitting encroachment of summer weeds with resulting hay yield reductions and weed content increases, both highly significant.

On the spring-seeded blocks yields of hay in the same year were not significantly different between any treatments. Yield of untreated check (2 cuts) was 3430 lb/A of which 900 lb was weeds. Compared to the check, increases for alfalfa hay were highly significant for EPTC at 3 and 9 lb/A surface-applied and 3 lb/A incorporated, whereas all other treatments resulted in highly significant reductions. Compared to the check, reductions in yield of weeds in the hay were highly significant in all herbicide treatments except those in which dalapon was used post-emergence. (Department of Agronomy, Kentucky Agr. Exp. Sta.).

Pre-and post-emergence herbicides for weed control in alfalfa. Peters, E. J., and Davis, F. S. Vernal alfalfa was sown on April 13, 1959, on Mexico silt loam near Columbia, Missouri. Herbicides, rates per acre, and methods of application were as follows: 1 and 2 lb of neburon, and 15 lb EPTC (liquid), pre-emergence; 1, 2, and 3 lb of EPTC as liquid and granular material disked into the soil before planting; post-emergence treatments of ½ and 1 lb of 4-(2,4-DB); 1 lb of 4-(2,4-DB) mixed with 2 lb of sodium salt of dalapon applied when the alfalfa was 3 to 4 in. tall; and 1 lb of 4-(2,4-DB) applied when the alfalfa was 3 to 4 in. tall, followed by a 2-lb application of dalapon after the first cutting. All material except granular EPTC was applied in water at 40 gal per acre. A heavy infestation of smartweeds and lesser amounts of pigweeds and crabgrass were present.

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EPTC at 15 lb per acre was the best weed control treatment and kept plots nearly free of weedy grasses all summer. Broadleaved weeds were controlled until the alfalfa was large enough to shade the ground. Consequently, broadleaved weeds were not a problem. Preplanting applications of 2 and 3 lb of EPTC were slightly less effective than 15 lb pre emergence. Weedy grass control was good, but broadleaved weeds came in to some extent. The 1-lb rate of EPTC was inadequate. All rates of EPTC caused severe stunting of some alfalfa plants, but the number of severely injured plants never exceeded 5 percent. Neburon at 1 and 2 lb gave weed control equal to EPTC at 2 and 3 lb. Alfalfa treated with neburon was somewhat taller than alfalfa treated with EPTC. Good control of broadleaved weeds was obtained with 4-(2,4-DB). Two lb of dalapon applied after the first cutting following an earlier application of 1 lb of 4-(2,4-DB) was more effective for controlling grass than 2 lb of dalapon mixed with 4-(2,4-DB) applied when alfalfa was 3 to 4 in tall. All post-emergence treatments injured alfalfa to some extent and yields from post-emergence treatments were less than yields from pre-emergence and pre-planting treatments. Granular EPTC was about equal to liquid EPTC. About 80 percent of the weeds were controlled by all treatments except EPTC at 1 lb/A.

(Contribution of the Crops Research Division, ARS-USDA and Missouri Agr. Exp. Sta., cooperating.)

Pre- and post-emergence herbicides for weed control in red clover and birdsfoot trefoil. Peters, E. J., and Davis, Frank S. Kenland red clover and European birdsfoot trefoil were planted on April 14, 1959, on Mexico silt loam at Columbia, Missouri. The following herbicides, methods of application, and rates per acre were used: 15 lb of EPTC pre-emergence; 1, 2 and 3 lb of EPTC as liquid and granular material disked into the soil before planting, and 1 and 2 lb of EPTC disked into the soil before planting followed by post-emergence treatments with ½ lb of the amine salt of 4-(2,4-DB). In addition to the treatments listed, red clover received a post-emergence treatment with 4-(2,4-DB) when it was 1 to 3 in. tall and birdsfoot trefoil received treatments with a mixture of 1 lb of 4-(2,4-DB) and 3 lb of sodium salt of dalapon, applied post-emergence when it was ½ to 2 in. tall. The treatment consisting of a mixture of 1 lb of 4-(2,4-DB) and 3 lb of dalapon was repeated and an additional 3-lb rate of dalapon was applied in mid-summer after birdsfoot trefoil was harvested. All materials except the granules were applied in water at 40 gallons per acre. The most prevalent weeds were annual smartweeds, pigweeds, and crabgrass.

About 50 percent of the red clover plants were severely stunted by all treatments with EPTC, but birdsfoot trefoil plants were not injured by herbicidal treatments. No injury to red clover was apparent from treatments with 4-(2,4-DB). Crabgrass appeared after about 8 weeks in plots treated with 1 lb of EPTC, but control lasted several weeks longer with the higher rates. Two and 3 lb of EPTC were about equal for weed control. Some pigweeds came into EPTC-treated plots and were eliminated where 4-(2,4-DB) was used as a supplemental treatment. Mixtures of dalapon and 4-(2,4-DB) were somewhat more effective than EPTC for weed control in birdsfoot trefoil. The most outstanding control of weed grasses occurred where dalapon was used in mid-summer following a treatment with a mixture of 4-(2,4-DB) and dalapon. Granular EPTC was about equal in effectiveness to the liquid form of EPTC. (Contribution of the Crops Research Division, ARS-USDA, and Missouri Agr. Exp. Sta., cooperating.)

Pre-planting and pre-emergence treatments with EPTC for annual grass control on spring-planted alfalfa. Wick, Carl M., and Elder, W. C. A heavy uniform rate of crabgrass seed was broadcast on the test area. EPTC was applied at 2, 4, and 8 lb/A as pre-planting soil incorporation treatments using liquid and granular formulations. The same rates were applied as pre-emergence treatments with the liquid formulation. Sprinkler irrigation was used to encourage quick germination of alfalfa and grass seed. Stand counts were made on the alfalfa and grass 20 days after planting. The plots were clipped three times during the season and botanical analyses were made to determine the effect of the treatments on production of alfalfa and grass. Stand counts showed no effect of treatments upon alfalfa emergence. Observations made four weeks after emergence indicated some retarded growth of the alfalfa plants in the 8 lb/A treatments. The granular form caused some yield reduction in the first cutting. All treatments controlled crabgrass for 20 days after emergence but heavy rains during the growing season increased grass germination. In this test, rates of EPTC were more important than methods of application.

Treatment EPTC, lb/A	Application	Alfalfa total lb/A	Grass total lb/A
2	Pre-emergence	2880	670
4	Pre-emergence	3350	440
8	Pre-emergence	3580	300
2	Incorporated	2860	840
4	Incorporated	3500	320
8	Incorporated	3260	270
2	Granular Incor.	3130	720
4	Granular Incor.	2680	850
8	Granular Incor.	2170	360
Ck		1120	3060

(Contribution of the Agronomy Department, Oklahoma Agr. Exp. Sta., Stillwater.)

OTHER FIELD CROPS

Herbicides for weed control in sugar beets. Chubb, W. O. Seed of wild oats and green foxtail was broadcast and mixed in the soil with a disk harrow and the next day preplanting treatments were sprayed on the soil and incorporated with a disk harrow. Total spray volume (water diluent) was 20 (Imp) gal/A. Sugar beets were sown the same day. Treatments were EPTC at 2 and 4 lb/A, endothal at 3 and 6 lb/A, Avadex or CP 15336 (2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture) at 1 and 2 lb/A, check and weeded check. Dalapon was applied at 2 and 4 lb/A in 10 (Imp.) gal/A water when the beets were in 3 to 5-leaf stage; green foxtail up to 4 leaves, ca. 6 inches tall; wild oats 3 leaves and stooled, up to 12 inches tall. There were four replicates on a fertile clay loam soil. Rainfall in the three weeks following preplanting treatments was 0.69, 0.81 and 0.17 inches. Estimated percent control of wild oats and green foxtail, and yields (tons/A) were as follows: Weeded, 100, 100, 19.2; EPTC 2 lb, 55, 100, 12.2; EPTC 4 lb, 100, 100, 14.5; Avadex 1 lb, 75, 0, 7.1; Avadex 2 lb, 100, 0, 9.0; endothal 3 lb, 0, 0, 7.8; endothal 6 lb, 0, 0, 9.5; dalapon 2 lb, 0, 100, 9.5; dalapon 4 lb, 95, 100, 9.5; check, —, —, 6.5. Infestation on the checks ranged up to 25 wild oats and 45 green foxtail per square foot. Analysis of the data suggests that a major proportion of the differences between weeded and treated plots can be attributed to the weed competition and not to the effect of the herbicides, at least for the preplanting treatments. (Contribution from Canada Agriculture, Research Branch, Portage la Prairie, Manitoba.)

Effect of herbicides on seed production of Kentucky bluegrass. Freeman, J. F. Second-year Kentucky bluegrass, fairly free of weeds and located on Maury silt loam, was mowed, raked, and fertilized with ammonium nitrate 100 lb/A during first week of March 1958. One set of quadruplicated plots 6 x 23 ft in size was sprayed

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April 14 near optimum date for treating for wild garlic control and a second set was sprayed May 7 as panicles began to show and when the needed insecticide was applied uniformly to all plots. Herbicides were applied in water, 28 gal/A. Treatments were alkanolamine salts of 2,4-D, ½, 1, 1½ and 2 lb/A; PGBE ester of 2,4-D, ½, 1, 1½ and 2 lb/A; sodium salt of 2,3,6-TBA, 2, 4, and 8 lb/A, and unsprayed check. A 3 x 20 ft area in each plot was harvested for yield June 12. Later, seed was threshed, lint removed, and recleaned. Yield of seed, test weight per bushel, and germination were determined for each plot. Of the treatments applied April 14 only 2,3,6-TBA, 8 lb/A resulted in a significant reduction in yield of seed below that of the check which produced 267 lb/A, tested 24.6 lb/bu, and germination of 85%. None of them had significantly lower test weight or lower germination than the check. Of the treatments applied May 7, 2,3,6-TBA at 4 and 8 lb/A resulted in highly significant yield and test-weight reductions; at 2 lb/A in significant yield reduction; and PGBE ester of 2,4-D, 2 lb/A, in significant yield and test weight reductions. None of the treatments reduced germination percentage significantly. In an adjacent experiment, herbicide treatments were applied the preceding fall Oct. 10, 1957 on closely clipped and lightly disked sod simulating treatments for pre-emergence control of chess in bluegrass sod. Treatments were simazin ½, 1 and 2 lb/A; neburon, 1, 2, and 4 lb/A; CIPC 2 and 4 lb/A; CDAA (5% granules) 4 and 8 lb/A; NPA (20% granules) 2, 4 and 8 lb/A; amine salts of PBA 1, 2, and 4 lb/A as fall treatment, plus sodium salts of 2,3,6 TBA at 2, 4, and 8 lb/A respectively as spring treatment (April 14 1958); and untreated check. Simazin, 2 lb/A killed the sod and 1 lb/A destroyed much of it and resulted in highly significant reductions in yield of seed and bushel test weight. None of the other herbicide treatments reduced yields or test weight significantly compared with the check, but use of NPA at 8 lb/A resulted in highly significant increases in yield of seed and neburon at 4 lb/A in a significant increase in yield. (Department of Agronomy, Kentucky Agr. Exp. Sta.)

Herbicides for weed control in tobacco. Freeman, J. F. Burley tobacco was transplanted in Maury silt loam soil at Lexington June 9, 1959. Triplicate 3-row plots each 47 feet long were treated as follows: EPTC, 2, 3, and 4 lb/A, incorporated with soil 1 day before transplanting; EPTC 2 and 3 lb/A, incorporated with soil, and 4 lb/A surface-applied, 1 day after transplanting; 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine (Trietazine), 2 and 3 lb/A surface-applied 1 day before transplanting; Trietazine 2, 3, and 4 lb/A surface-applied 1 day after transplanting; cultivated check; and uncultivated check. All herbicides were applied broadcast in 25 gal/A water spray, post-transplanting treatments being sprayed over the tobacco. Hot, dry weather for 10 days after transplanting delayed establishment of the young tobacco and resulted in the death of some plants and severe stunting of others particularly on treatments with heaviest rates of herbicide. Principal weeds were crabgrass, redroot pigweed, and spiny sida, which began emerging 2 weeks after treatment. The number of weeds in a 2′ x 45′ band over the middle row of each plot was determined July 12. Based on the number of weeds in the uncultivated check—17 weeds/sq ft —treatments resulted in reductions as follows: EPTC, 2, 3, and 4 lb/A incorporated, pre-planting, 61, 88, and 98%; EPTC, 2 and 3 lb/A incorporated, post-planting, and 4 lb/A surface, postplanting, 55, 76, and 60%; Trietazine, 2 and 3 lb/A surface, preplanting, 85 and 87%; Trietazine 2, 3, and 4 lb/A surface postplanting, 82, 91 and 93%; and cultivated check 93%. Intended cultivation of all plots after weed counts were made was delayed for two weeks by wet weather and resulting weed growth where early control had been poorest resulted in some stunting of the tobacco. At harvest time tobacco showed little or no reduction in growth or maturity of plants (compared with cultivated check) for EPTC 3 lb/A incorporated, either pre- or post-planting, or Trietazine 2 lb/A surface, preplanting. These treatments had resulted in good weed control for several weeks after transplanting, and in comparatively little injury immediately following transplanting. (Department of Agronomy, Kentucky Agr. Exp. Sta.)

Rates of DMTT and drench-water for pre-seeding control of weeds in tobacco plant bed soils. Freeman, J. F. DMTT (Mylone 50-D formulated with bran as the carrier) was applied broadcast on 4½′ x 6′ quadruplicate plots in Maury silt loam soil October 3, 1958. Soybeans as a green manure crop had been plowed under 1 month earlier. The area was rototilled the day before fitting the soil and treating. Treatments were: DMTT 6, 7½, and 9 lb/100 sq yd, with each rate drenched into the soil with 0, 150 and 300 gal water; and untreated check. The soil was protected from additional wetting for 2 weeks following treatment by covering the area with plastic sheeting during short periods when showers occurred or threatened. Rainfall was very light during October, November and December. On March 23, 1959, after soil of fall-treated plots was scarified to depth of 1 inch and that of untreated check to depth of 4 inches, the area was raked smooth, fertilized and seeded with Ky 16 tobacco. None of the treatments reduced emergence or early growth of the tobacco. During early May weeds were pulled, classified as to species, and numbers determined in a 2½′ x 4′ area for each plot. Compared with the untreated check which had 1256 weeds/10 sq ft (375 broadleaf and 881 grass) DMTT, as the mean of all treatments reduced number of weeds 90%. Differences in reductions for the various rates were not significant; however, the trend was for greater reduction with increasing rate of herbicide. Water-drenching of herbicide into the soil had little effect on reduction in weed numbers in this experiment—the undrenched treatments resulting in almost as great reduction as heavily-drenched treatments. In an adjacent experiment, treated 10 days later, DMTT and calcium cyanamide were used singly and in various rate-combinations on triplicate plots. Treatments rates/100 sq yd were: DMTT 6 lb; calcium cyanamide 150 lb; combinations of DMTT plus calcium cyanamide 2+100 lb, 3+75 lb, and 4+50 lb; and untreated check. Half of the calcium cyanamide of each treatment was incorporated with the soil to 3″ depth and half applied on the surface. DMTT was broadcast on the surface. All treatments were drenched with water 150 gal/100 sq yd. DMTT used singly resulted in 69% reduction in number of weeds, and good production of tobacco plants; calcium cyanamide used singly resulted in 90% reduction of weeds and very poor production of plants; and combinations of the two resulted in about the same weed reduction as for DMTT alone but in poorer production of plants. (Department of Agronomy, Kentucky Agr. Exp. Sta.)

Herbicides for weed control in sunflowers. Robinson, R. G. and Soine, O. C. CDAA at 4 lb/A pre-emergence has given good *Setaria* control, partial non-grass weed control, and no sunflower injury in trials at Sleepy Eye in 1956, Crookston in 1958, and Rosemount in 1959, but did not increase yield significantly. Varietal trial and breeding plots at Rosemount have been sprayed in 1957 to 59 and no sunflower injury occurred. CDAA at 6 lb/A did not injure sunflowers in the Crookston trial, but CDAA at 6 lb/A plus trichlorobenzyl chloride resulted in some injury. CDAA, 6 lb/A, applied at the 1- to 2-inch stage, injured sunflowers.

Simazin, 2 lb/A, greatly reduced sunflower yield. Sunflowers were resistant to EPTC and were not injured by 15 lb/A on the soil surface in the Crookston trial nor by 3 lb/A raked into the soil at Rosemount. Striped gophers (*Citellus* spp.) did not dig up sunflower seed in the plots sprayed with EPTC, whereas they were a serious problem in other plots. (Contribution from

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the Department of Agronomy and Plant Genetics, Univ. of Minnesota, St. Paul, and the Northwest School and Station, Crookston. Paper No. 4255, Sci. Jour. Series, Minnesota Agr. Exp. Sta.)

CDAA and EPTC for weed control in crop species of potential industrial uses. Robinson, R. G. Fourteen species were rated for tolerance to pre-emergence applications of CDAA and EPTC. Planting dates of May 5, May 19, and June 2 were compared. Spraying was done immediately after planting. Herbicide treatments were replicated 14 times on weeds and once on crops at each planting date. CDAA was applied at 4 lb/A and EPTC at 3 lb/A in spray volumes of 40 gal/A. EPTC was raked into the soil after spraying. Crops were grown in rows 40 inches apart and tractor-cultivated; spray was applied in a band 13 inches wide over each row and herbicide rates are quoted on actual ground area sprayed.

CDAA applied May 5 was effective on neither crops nor weeds, applied May 19 gave fair control of susceptible weeds, and applied June 2 gave good control of susceptible weeds. Results with EPTC were similar, although the May 5 application gave partial weed control. Soil temperatures in this field at Rosemount, Minnesota were generally low until late May. Low temperatures resulted in slow, uneven emergence of weeds, and this may account for the relatively poor control achieved by CDAA or EPTC applied in May.

Crop species were rated resistant, moderately resistant, moderately susceptible, susceptible, or very susceptible to the herbicides, as given in the table.

Crop	CDAA	EPTC
Helianthus annuus	R	R
Eruca sativa	R	MS
Raphanus sativus	R	MS
Euphorbia marginata	R	MS
Crambe abyssinica	MR	S
Brassica campestris	MS	MS
Brassica spp. (NU 19725)	MS	VS
Sorghum almum	MS	—
Daucus carota	S	VS
Rudbeckia bicolor	S	S
Eupatorium rugosum	S	MS
Satureja hortensis	S	VS
Nepeta mussinii	S	VS
Matthiola bicornis	VS	VS

Ratings of R or MR indicate that the herbicide did not appreciably affect the crop on plots where weed control was good.

Striped gophers (*Citellus* spp.) dug up and ate much of the *Helianthus annuus* seed planted June 2 on the unsprayed and CDAA-sprayed plots but did not dig in the EPTC-sprayed plots. (Contribution from the Department of Agronomy and Plant Genetics, Univ. of Minnesota, St. Paul 1. Paper No. 4257, Sci. Jour. Series, Minnesota Agr. Exp. Sta.)

Pre-emergence applications of herbicides on rapeseed, 1959. Selleck, G. W. CIPC, IPC, and *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron) at initial rates of 16 lb/A and Urab (3-phenyl-1,1-dimethylurea trichloroacetate) at an initial rate of 16 lb /A were applied wth a variable rate sprayer on duplicated, 15 x 135 ft plots and incorporated with a double disk May 11 on silty clay loam soil at Saskatoon. The herbicides were applied in 34 gal water. Argentine rapeseed was seeded May 12. The data are presented as a fraction, the numerator representing the rate of application (lb/A) and the denominator the resulting percentage control.

Crop or weed	CIPC		IPC		Urab		
Rapeseed	12	8.0	12	6.0	5.0	2.2	2.0
	65	30	90	20	90	70	0
Brassica arvensis	13	10	11	7.0	3.0	....	....
	65	35	50	20	80		
Thlaspi arvense	....	....	....	....	5.0	3.7	2.2
					100	90	60
Avena fatua	....	....	....	....	2.2	....	....
					100		

Zytron had no visible effects on any of the crops or weeds which were present. (Contribution No. 261 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agr. Research Foundation.)

Pre-planting herbicide treatments for the control of wild oats in sugar beets. Sexsmith, J. J. Sugar beets were seeded into 22-ft x 4-row quadruplicate plots on a silty clay loam irrigated soil on May 14, 1959, at Lethbridge, Alberta. The plot area contained a light infestation of wild oats which was added to by a broadcast seeding on May 13. Immediately prior to beet seeding the following herbicides were applied to soil surface and incorporated to a depth of 2 to 3 inches using a double disk in two directions: IPC and CDAA at 4, 6, and 8 lb/A; TCA at 10, 15, and 20 lb/A; EPTC at 2, 3, and 4 lb/A; and 2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture (Avadex), at 2, 4, and 6 lb/A. On June 4 wild oat stand counts were obtained from four drops per plot of a 5-in x 5-ft frame, and unthinned beet stands were determined by counts taken in four 5-ft row lengths per plot. Thinning and weeding were done on June 22, and the operation was timed for each plot. Roots were harvested on September 23 from 44 ft of row, numbers of beets were recorded, and a sugar analysis was obtained. Wild oat control was 76% from TCA at 20 lb, 80% from CDAA at 8 lb, and 84% from IPC at 8 lb. Much better control was obtained from the other two herbicides, 94% from EPTC at 3 lb and 96% from Avadex at 2 lb. Unthinned beet stands were reduced slightly by most treatments, the reduction being less than 25% from all rates of TCA and Avadex, 4 lb of IPC and CDAA, and 2 and 3 lb of EPTC. However, at harvest a uniformly good stand of beets was present on all plots, indicating that a stand reduction of unthinned beets of as much at 43% (CDAA at 8 lb) due to treatment was of no consequence. Thinning and weeding time-data showed that where a wild oat control of over 90% was obtained the operation took 4/7 the time required for the same operation on untreated plots. Based on the average for all five herbicides, a significant yield increase of sugar beet roots amounting to approximately 1 ton/A resulted from the low and medium treatment rates. None of the treatments affected the sucrose content of the roots. (Canada Agriculture, Research Station, Lethbridge, Alberta.)

Herbicides on sugar beets. Stroube, E. W. and Bondarenko, D. D. Sugar beets were planted in 32-inch rows in Hoytville silty clay loam at the Northwest Substation, Hoytville, on April 15, 1959, and in Toledo clay at the North Central Substation, Castalia, on April 22. German millet was sown in all plots to simulate annual grasses. At Hoytville there was a natural infestation of smartweed and common ragweed; at Castalia, common ragweed, lambsquarters and velvet leaf. The treatments were replicated four times at Castalia and three times at Hoytville. All herbicides were applied in 40 gpa water except the granular materials, which were applied dry. The plots treated pre-planting were disked immediately after application and planted to beets the same day. The pre-emergence herbicides were applied immediately after planting. The treatments were similar at Hoytville and Castalia.

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Liquid and granular formulations of EPTC and endothal were applied at 1½, 3 and 6 lb/A pre-planting and pre-emergence. DCU was applied at 6 lb/A pre-planting. Dalapon at 1½ and 3 lb/A and TCA at 3 and 6 lb/A were applied pre-emergence. Dalapon at 3 and 6 lb/A, TCA at 6 lb/A and endothal at 1 and 2 lb/A were applied at the 2- to 4-leaf stage.

Ratings were made on May 29 at Hoytville and June 2 at Castalia. EPTC liquid and granular at 3 and 6 lb/A applied pre-planting and pre-emergence gave good to excellent control of weeds at both locations but poor control at 1½ lb/A. EPTC liquid and granular applied at 3 and 6 lb/A pre-planting and pre-emergence reduced the stand of the beets somewhat at both locations, but the surviving plants developed satisfactorily. At Hoytville endothal liquid and granular at 6 lb/A pre-planting and pre-emergence and the liquid at 2 lb/A post-emergence reduced the weed stand 80 to 95%. The other endothal treatments at Hoytville and all endothal treatments at Castalia gave unsatisfactory weed control. Endothal at 2 lb/A post-emergence at Hoytville slightly injured the beets but they recovered quickly. All DCU and TCA treatments gave excellent control of millet but poor control of the broadleaf weeds. Dalapon at 3 and 6 lb/A pre- and post-emergence gave good control of millet but poor control of the broadleaf weeds. Dalapon at 1½ lb/A pre-emergence gave unsatisfactory weed control. (The Ohio Agr. Exp. Sta.)

WEED CONTROL IN HORTICULTURAL CROPS

VEGETABLES

Herbicides for weed control in potatoes. Brown, D. A. A crop of Kennebec (main crop) potatoes grown on Assiniboine clay loam soil was used for this experiment. All treatments were applied as over-all sprays in 15 gal/A of water several days before potato plants emerged. Pigweeds, stinkweed, tansy mustard and green foxtail were the main weeds but none was sufficiently prevalent to interfere with normal crop growth. Here is a summary of treatments (rates lb/A) each followed by percent weed control and yield of potatoes (brackets) in bu/A: TCA 3, 15% (278); 6, 28% (287); dalapon 1, 16% (315); 2, 18% (287); neburon 1, 18% (319); 2, 43% (403); diuron 1, 16% (280); 2, 34% (294); 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine (Trietazine) 2, 25% (305); 4, 36% (292); TCA+DNBP 3+1, 68% (254); dalapon+DNBP 1½+1, 73% 284); handweed (244); weedy check (333). Treatments did not significantly influence yield. The mixtures of TCA and dalapon with DNBP gave much the best over-all weed control. (Experimental Farm, Brandon, Manitoba)

Pre- and post-emergence herbicidal treatments for carrots on muck soil. Chambers, Everett, and Holm, LeRoy. Post-emergence. Red-cored Chantenay carrots were planted in a muck soil on May 27 in a replicated, randomized block experiment. The principal weeds in the area were Jimson-weed and rough pigweed. The treatments were made on June 10 when the carrots were 1½ inches tall, with the first two leaves evident. The weeds were 4 inches tall. A light rain fell just after the herbicides were applied. Weed counts were made on June 24 and the carrots were harvested on August 13. The herbicides and rates per acre were: Karsil (*N*-(3,4-dichlorophenyl)-2-methylpentanamide) 2 lb; Dicryl (*N*-(3,4-dichlorophenyl)methacrylamide) 4 lb; Amoben (3-amino-2,5-dichlorobenzoic acid as the triethylamine salt) 4 lb; Stoddard Solvent 80 gal/A; Stoddard Solvent 40 gal/A with CIPC 4 lb; Atrazine (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine) 4 lb; and Trietazine (2-chloro-4-ethylamino-6-diethylamino-*s*-triazine 4 lb/A. There was no injury to the carrots from any treatment except Atrazine, but that proved to be very toxic to the crop. Weed control was as follows: Atrazine, 100%; Trietazine, 90%; Dicryl, 90%; Stoddard solvent with CIPC, 75%; Karsil, 65%; Stoddard solvent, 65%; and Amoben, 40%.

Pre-emergence. In an area immediately adjacent which was planted on the same date, a pre-emergence experiment was carried out with the following treatments (rates per acre): Amoben, 2 and 4 lb; diuron, 1 lb; CIPC, 8 lb; Trietazine, 2 and 4 lb; Propazine (2-chloro-4,6-bis-(isopropylamino)-*s*-triazine), 2 and 4 lb; Ipazine (2-chloro-4-diethylamino-6-isopropylamino-*s*-triazine), 2 and 4 lb; Urab (3-phenyl-1,1-dimethylurea trichloroacetate) 3 lb; and the combination of diuron ¾ lb with TCA 8 lb/A. The herbicides were applied immediately after planting. Weed counts were made on June 24 and the carrots were harvested on August 31. There was no injury to the carrots from any treatment and the control of weeds was as follows: Ipazine 2 and 4 lb, 55 and 60%; Propazine 2 and 4 lb, 55%; Amoben 2 and 4 lb, 50%; Trietazine 2 and 4 lb, 25 and 45%; diuron plus TCA, 25%; CIPC, 20%; Urab, 20%; and diuron alone, 10%. (Contribution from the Department of Horticulture, Wisconsin Agr. Exp. Sta.).

Control of some weeds growing in asparagus. McCurdy, E. V. An old stand of asparagus, severely infested with Canada thistle, sowthistle, dandelion, and couchgrass, was divided into plots in 1958. Herbicides were applied to assess damage to asparagus and control weeds. The plots were rototilled before growth started in 1959. Herbicides were applied in June 1959, as soon as most weeds were making active growth. Amitrol at 8 lb/A did not injure the asparagus and resulted in a severe setback to Canada thistle but not to purslane and redroot pigweed. Slight injury to the asparagus was noted at 12 lb/A. Amitrol was also used as 8 lb/A in combination with dalapon at 20 lb/A. The asparagus was slightly retarded but appeared normal this fall. Most weeds, with the exception of redroot pigweed, were quite well controlled. Amitrol plus ammonium thiocyanate (Amitrol-T) at 2 lb/A did not injure the asparagus but did not control weeds. Canada thistle made considerable regrowth. 2,3,6-TBA at 12 lb/A applied in 1958 resulted in serious distortion of the asparagus plants in 1959. With a combination of herbicides and cultivation the weeds in this asparagus have been well controlled. (Contributed by the Experimental Farm, Indian Head, Saskatchewan).

Pre-emergence weed control in processing peas, 1959. Nelson, D. C., Nylund, R. E., Dinkel, D. H., and Weaver, M. L. Processing peas seeded at three locations in Minnesota, (May 12 at Fairmont in sandy loam, and at Stewartville in silt loam, and May 14 at Stewart in silty clay loam) were sprayed with the following herbicides (rates per acre): 2 lb monuron; 2 lb diuron; 4 lb CDAA; 4 lb CDAA-S (solventless); 5 and 15 lb *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron, M-1329; 2 and 4 lb triethylamine salt of 3-amino-2,5-dichlorobenzoic acid (Amoben M-729); 4 and 8 lb dimethyl 2,3,5,6-tetrachloroterephthalate (DAC 893); 4 lb 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine (Trietazine, G-27901); and 2 lb EPTC. EPTC was incorporated into the soil with a rake immediately after application. Herbicides were applied at 30 psi pressure in 40 gpa of water to duplicated one-half square rod plots. Every third plot was an unsprayed check. Herbicides were applied not more than four days after seeding to a moist soil at Stewart, and dry soils at Stewartville and Fairmont. Rain for the week following totaled .58″ at Stewart, .48″ at Stewartville and 1.14″ at Fairmont. Weed control and pea injury ratings were recorded three to four weeks after spraying. Dominant weed species at Stewart were *Polygonum persicaria, Chenopodium album, Amaranthus retroflexus, Echinochloa crusgalli* and *Setaria* spp. and at Stewartville were *Brassica kaber, C.*

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album, *P. persicaria*, *E. crusgalli*, and *Setaria* spp. Weeds were not present in sufficient numbers at Fairmont for accurate ratings. At Stewart and Stewartville 80 to 100% control of both broad-leaved and grassy weeds was obtained with 4 lb M-729 and 15 lb Zytron, 80 to 100% control of only grassy weeds was obtained with 4 lb CDAA, 4 lb CDAA-S, and 1 lb monuron plus 2 lb CDAA, and 90% control of only broad-leaved weeds was obtained with 4 lb Trietazine.

Moderate injury to peas was caused by: 2 lb monuron and 4 lb M-729 at Fairmont, and 2 lb EPTC at all locations. (Paper No. 4236 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Post-emergence weed control in processing peas, 1959. Nelson, D. C., Nylund, R. E., Dinkel, D. H., Weaver, M. L. Processing peas, (var. Dark-skinned Perfection at Fairmont, Minnesota, var. Canner's New Line Perfection at Stewartville, and late canning var. #250 at Stewart) were sprayed with the following herbicides (rates per acre): 1½ and 3 lb DNBP amine, 2 and 4 lb 2 chloro-4-ethylamino-6-diethylamino-*s*-triazine (Trietazine, G-27901), ¾ lb dalapon, 6 oz alkanolamine salts of MCPA, 6 oz potassium salt of MCPA, (Kalzate) 6 and 12 oz of dimethylamine salt of 4-(2-,4-DB), 6 oz mixed Rb and Cs salts of MCPA, 6 oz lithium salt of MCPA, and mixtures of ¾ dalapon with 6 oz Kalzate, 1½ lb DNBP amine, and 6 oz MCPA. In addition 1 lb dalapon, granular, was applied dry. Each liquid herbicide was applied at 30 psi pressure in 40 gpa of water to duplicated one-half square rod plots. Every third plot was an unsprayed check. On the day of spraying, at Stewart and Sewartville, peas had 7 to 8 nodes, broad-leaved weeds had two to four true leaves and grassy weeds up to four leaves. At Fairmont peas had 9 nodes, but no weeds had emerged. At the time of spraying weather conditions were similar at all locations (temp 90° to 95° F, humidity 35 to 40% and soil surface dry). Dominant weed species at Stewart were *Polygonum persicaria*, *Chenopodium album*, *Amaranthus retroflexus*, *Setaria* spp. and *Echinochloa crusgalli* and at Stewartville were *Brassica kaber*, *C. album*, *P. persicaria*, *Setaria* spp. and *E. crusgalli*. The first rain fell two days after spraying at Stewart and Fairmont and three days after spraying at Stewartville. For the week following spraying rainfall totaled .62″ at Stewart and Fairmont, and .46″ at Stewartville. Pea injury ratings were recorded 15 days after spraying at Stewart and Fairmont and 24 days after spraying at Stewartville.

Weed control ratings were recorded only at Stewart and Stewartville. No herbicide tested gave commercially acceptable control of grassy weeds at either Stewart or Stewartville, but acceptable weed control of broad-leaved weeds was obtained with 3 lb DNBP amine, 2 and 4 lb Trietazine, 6 oz MCPA and 6 oz Kalzate plus ¾ lb dalapon, at both locations. There was no significant herbicide by location interaction. No herbicide tested caused more than slight injury to peas. (Paper No. 4244 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Pre- and post-emergence weed control in four vegetable crops on mineral soil, 1959. Nylund, R. E.; Nelson, D. C., Weaver, M. L.; and Dinkel, D. H. Baby Fordhook lima beans, Topcrop snap beans, Straight Eight cucumbers and Perfection Freezer peas were seeded on May 13, in Waukegan silt loam, at St. Paul, Minnesota. Pre- and post-emergence herbicides were applied with a logarithmic sprayer at 30 psi pressure in 74 gpa water to duplicated plots. Each plot consisted of four 130′ rows (single rows of each crop) seeded 15″ apart. Mustard and millet used as weeds were broadcast immediately after soil preparation on May 13. Pre-emergence herbicides were applied the day after seeding (temp 40°F and soil moist). Immediately after spraying 0.03″ rain fell, followed by .47″ six days later. Air temp for the week following spraying averaged 57°F. Weed control and crop injury ratings were recorded 23 days after spraying. Preceding each of the following pre-emergence herbicides is the lowest rate/A giving satisfactory broad-leaved weed control followed by the lowest rate/A giving satisfactory grassy weed control: 2 and 2 lb, 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine (Trietazine, G-27901); 0.5 and 2.6 lb, 2-chloro-4,6-bis-(isopropylamino)-*s*-triazine (Propazine, G-30028); 2.4 and 1.5 lb, triethylamine salt of 3-amino-2,5-dichlorobenzoic acid (Amoben M-729); 6.0 and 2.3 lb. dimethyl 2,3,5,6-tetrachloroterephthalate (DAC 893); 0.8 and 0.6 lb, dimethylamine salt of 2-methoxy-3,6-dichlorobenzoic acid (Velsicol B); 2.3 and 2.3 lb dimethylamine salt of 2-methoxy-3,5,6-trichlorobenzoic acid (Velsicol C); and 4.8 and 4.2 lb, *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron, M-1329). The following pre-emergence herbicides were most promising: for lima and snap beans, 2.0 to 2.5 lb Trietazine, 2 to 5 lb Amoben, 4 to 8 lb Zytron, and 3 to 5 lb DAC 893; for cucumbers, 2.0 to 3.5 lb Amoben, and 4 to 5 lb Zytron; for peas 2 to 3 lb Trietazine, 2 to 6 lb DAC 893, 1.5 to 3.0 lb Amoben, and 4 to 8 lb Zytron.

Post-emergence herbicides were applied as over-all sprays on June 5 (temp 75°F, humidity 50% and soil moist) when cucumbers had one true leaf, beans two true leaves, peas five nodes, mustard four leaves, and millet two to three leaves. The first rain (.30″) occurred on the fifth and sixth days following spraying. Air temp during the six days following spraying averaged 78°F. Weed control and crop injury ratings were recorded 10 days after spraying. Preceding each of the following post-emergence herbicides is the lowest rate/A giving satisfactory broad-leaved weed control followed by the lowest rate/A giving satisfactory grassy weed control: 2.6 and 4.0 lb Trietazine; 3.0 and 3.6 lb Propazine; 3.6 and 3.0 lb Amoben; 0.5 and 0.5 lb *N*-(3-chloro-4-methylphenyl)-2-methylpantanamide (N-4512); 1.2 and 0.6 lb *N*-(3,4-dichlorophenyl)methacrylamide (N-4556); 0.2 and 0.6 lb *N*-(3-4-dichlorophenyl)-2-methylpentanamide (N-4562); 3.6 and 2.3 lb 2,6-dichlorobenzonitrile (N-5996); 0.5 and 0.5 lb Velsicol B; 0.9 and 2.5 lb Velsicol C; 9.0 and 9.0 lb Zytron; 0.1 and 0.4 lb 3-(3-4-dichlorophenyl)-1-isopropyl-1-(2-propynyl)urea (CP-10543); and 0.9 and 0.9 lb 2-isopropylamino-1,4-naphthoquinone (B-562). The following post-emergence herbicides were most promising: for lima beans 2.5 to 4.0 lb N-5996; for cucumbers 2 to 4 lb Amoben, and 1.0 to 1.5 lb N-4556; and for peas 0.5 to 1.0 lb N-4512 and 0.5 to 1.0 lb CP-10543. (Paper No. 4248 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Pre- and post-emergence weed control in four vegetable crops on muck soil, 1959. Nylund, R. E.; Weaver, M. L.; Dinkel, D. H. and Nelson, D. C. King Red beets, Danish Ballhead cabbage, Nantes carrots and Trapp's Downing Yellow Globe onions were seeded on April 16 in muck soil at Excelsior, Minnesota. Pre- and post-emergence herbicides were applied with a logarithmic sprayer at 30 psi pressure in 74 gpa water to duplicated plots. Each plot consisted of four 130′ rows (single rows of each crop) seeded 12″ apart. The dominant weeds were *Amaranthus* spp. *Polygonum* spp., *Brassica* spp., *Setaria* spp. and *Echinochloa crusgalli*. Pre-emergence herbicides were applied on April 23 (temp 49° F, humidity 32% and soil dry) before crops or weeds emerged. A rain of 0.16″ was recorded the fourth day after spraying. Air temp for the week following spraying averaged 49° F. Weed control and crop injury ratings were recorded 37 days after spraying. Preceding each of the following pre-emergence herbicides is the lowest rate/A giving satisfactory broad-leaved weed control followed by the lowest rate/A giving satisfactory grassy weed control: 5 and 6 lb 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine (Trietazine, G-27901); 5.5 and 5.0 lb 2-chloro-4,6-bis(isopropylamino)-*s*-triazine (Propazine, G-30028); 3 and 3 lb triethylamine salt of 3-amino-2,5-dichlorobenzoic acid (Amoben, M-729); 6 and

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6 lb dimethyl 2,3,5,6-tetrachloroterephthalate (DAC 893); 1.2 and 1.5 lb 2-methoxy-3,6-dichlorobenzoic acid (Velsicol B); 2.8 and 3.0 lb 2-methoxy-3,5,6-trichlorobenzoic acid (Velsicol C); and 10 and 10 lb *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron, M-1329). The following pre-emergence herbicides were most promising: for beets 3 to 4 lb Amoben; for cabbage 3 to 6 lb Amoben, and 1 to 3 lb Velsicol B; for carrots 3 to 6 lb Amoben, and 1 to 3 lb Velsicol B. Post-emergence herbicides were applied as over-all sprays on May 19 (temp 50° F and soil surface wet) when onions had one true leaf, carrots, cabbage and beets two true leaves, and weeds one to four leaves. During the six days following spraying rainfall totaled 0.88″ and air temp averaged 56° F. Weed control and crop injury ratings were recorded 14 days after spraying. Preceding each of the following post-emergence herbicides is the lowest rate/A giving satisfactory broad-leaved weed control followed by the lowest rate/A giving satisfactory grassy weed control: 1.2 and 1.4 lb Trietazine; 1.4 and 2.6 lb Propazine; 2 and 2 lb Amoben; 1.2 and 1.4 lb *N*-(3-chloro-4-methylphenyl)-2-methylpentanamide (N-4512); 1.4 and 1.2 lb *N*-(3,4-dichlorophenyl)methacrylamide (N-4556); 0.3 and 0.3 lb *N*-(3,4-dichlorophenyl)-2-methylpentanamide (N-4562); 2.6 and 2.6 lb 2,6-dichlorobenzonitrile (N-5996); 0.8 and 0.8 lb Velsicol B; 1.2 and 3.0 lb Velsicol C; 7.5 and 5.8 lb Zytron; 0.5 and 0.5 lb 3-(3-4-dichlorophenyl)-1-isopropyl-1-(2-propynyl)urea (CP-10543). The following post-emergence herbicides were most promising: for beets, none; for cabbage, 1.5 to 3.5 lb Amoben, and 3 to 4 lb N-5996; for carrots, 2 to 4 lb Propazine, 2 to 4 lb Amoben, 1 to 5 lb CP-10543, 2 to 4 lb N-4556, 1 to 3 lb N-4562, and 2 to 4 lb N-4512; and for onions, 2 to 3 lb Trietazine, 2 to 3 lb Propazine, 1.5 to 4.0 Amoben, 3 to 4 lb N-5996, and 8 to 10 lb Zytron. (Paper No. 4245 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Pre-emergence weed control in onions grown on peat, 1959. Nylund, R. E.; Nelson, D. C.; Dinkel, D. H. and Weaver, M. L. Trapp's Downing Yellow Globe onions seeded ½″ deep in peat soil on April 20 were sprayed on April 27 with the following herbicides (rates per acre): 8 lb CIPC, 2 and 4 lb simazin, 1.6 monuron, 6 lb CDEC, 6 lb CDAA, 6 lb CDAA-S (solventless), 10 lb EXD, and mixtures of 4 lb CIPC plus 2 lb CDAA, and 0.8 lb monuron plus 2 lb CDAA. In addition the following granular herbicides were applied on May 5: 8 lb CIPC, 6 lb CDAA, and 4 lb smizain. All plots were 4′ wide and 16½′ long; treatments were replicated four times. Liquid herbicides were applied at 30 psi pressure in 40 gal water per acre. On April 27 the temp was 50° F and soil surface dry. On May 5 the temp was 68° F, humidity 98%, soil wet, and no weeds but 10% of the onions had emerged. Rainfall from April 27 to May 10 occurred on May 4 (.80″), May 5 (1.57″), and May 6 (.49″). Rain fell on May 5 immediately after the granular herbicides were applied. The 6-day average temp following application of liquid and granular herbicides were 64° F and 51° F respectively. Weed control and onion injury ratings were taken June 16 by comparing each treated plot with an adjacent untreated plot. Weeds consisted of 80% *Amaranthus* spp., 10% *Chenopodium album* and *Portulaca oleracea*, and 10% annual grasses. Commercially acceptable weed control was obtained with the following liquid herbicides: 2 lb CDAA plus 0.8 lb monuron, 1.6 lb monuron, and 2 and 4 lb simazin. Two lb CDAA plus 0.8 lb monuron did not injure onions, but 1.6 lb monuron caused moderate injury and 2 and 4 lb simazin killed onions. Two granular herbicides, 8 lb CIPC and 6 lb CDAA gave acceptable weed control without injuring onions. Two lb diuron granular gave very good weed control but severely injured onions.

Four lb simazin granular gave excellent weed control but killed onions. (Paper No. 4246 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Early post-emergence weed control in onions grown on peat, 1959. Nylund, R. E.; Nelson, D. C.; Dinkel, D. H. and Weaver, M. L. Trapp's Downing Yellow Globe onions seeded ½″ deep in peat soil on April 20 were sprayed with the following herbicides (rates per acre): 8 lb CIPC, 2 and 4 lb simazin, 6 lb CDEC, 6 lb CDAA, 6 lb CDAA-S (solventless), 1 and 3 lb 3-(3-4-dichlorophenyl)-1-isopropyl-1-(2-propynyl)urea, (CP 10543), 10 lb EXD, 1.6 lb monuron, and mixtures of 0.8 lb monuron plus 2 lb CDAA, and 4 lb CIPC plus 2 lb CDAA; or treated with the following granular herbicides: 2 lb diuron, 8 lb CIPC, 6 lb CDAA and 4 lb simazin. Each of the liquid herbicides was applied at 30 psi pressure in 40 gpa of water. All plots were 4′ wide by 16½′ long; treatments were replicated four times. Liquid and granular herbicides were applied on May 21, when onions had one true leaf and weeds were in the cotyledon stage. At the time of herbicide application the temp was 60° F and the soil very wet, (2.16″ rain the previous day). Rainfall for the day following application totaled .56″ and for the week following application totaled 1.90″. Air temp for the week preceding herbicide application averaged 57° F and for the week following 62° F. Weed control and onion injury ratings were made four weeks after spraying by comparing each treated plot with an adjacent untreated plot. Weeds consisted of 80% *Amaranthus* spp., 10% *Chenpodium album*, *Portulaca oleracea*, and *Ambrosia artemisiifolia*, and 10% annual grasses. All treatments gave some weed control, but only 1 lb CP 10543, 2 lb diuron granular, and 4 lb simazin granular gave commercially acceptable weed control with little or no injury to onions. Three lb CP 10543, 2 and 4 lb simazin liquid, and mixtures of 0.8 monuron plus 2 lb CDAA and 4 lb CIPC plus 2 lb CDAA gave commercially acceptable weed control, but caused moderate or severe injury to onions. (Paper No. 4231 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Late post-emergence weed control in onions grown on peat, 1959. Nylund, R. E.; Nelson, D. C.; Dinkel, D. H.; and Weaver, M. L. Trapp's Downing Yellow Globe onions seeded ½″ deep in peat soil on April 20, were sprayed with the following herbicides (rates per acre): 4 and 8 lb CIPC, 1.6 and 2.4 lb monuron, 10 lb EXD, 6 lb CDAA, 6 lb CDAA-S (solventless), and mixtures of 0.8 lb monuron plus 2, 4, and 6 lb CIPC, and 1.6 lb monuron plus 4 lb CIPC. In addition the following granular herbicides were applied: 6 lb CDAA, and 4 and 8 lb CIPC. All herbicides were applied on July 9, two weeks after the last cultivation, when the onions had 6 to 8 leaves. Liquid herbicides were applied as basal sprays at 30 psi pressure in 40 gpa of water, granulars were applied over-all with a 4′ Gandy applicator. All plots were 4′ wide and 16½′ long; treatments were replicated four times. At the time of treatment air temp was 72° F, humidity 55% and soil moist (.90″ of rain fell on the day prior to application). Temp during the 3 days preceding treatment averaged 70° F and during the week following treatment 72° F. The first rain following treatment occurred on July 17 (8 days after) when .97″ rainfall was recorded. At the time of treatment and rating the weeds consisted mostly of *Amaranthus* spp. and *Portulaca oleracea*. Weed control and onion injury ratings were recorded 3 weeks after herbicide application. Eighty to 100% weed control with only slight tip burn to the lower leaves of onions was obtained with the following sprays: 6 lb CDAA, 8 lb CIPC, 1.6 and 2.4 lb monuron, and all mixtures of monuron plus CIPC. Three sprays—6 lb CDAA-S, 4 lb CIPC, and 10 lb EXD—and all granulars, 4 and 8 lb CIPC and 6 lb CDAA, gave poor (10 to 50%) weed control, but did not injure onions. (Paper No. 4242 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Pre-emergence weed control in bush beans, 1959. Nylund, R. E.; Nelson, D. C.; Dinkel, D. H. and Weaver, M. L. Topcrop beans were seeded 1½″ deep in peat soil and sprayed on May 5 with the following herbicides

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(rates per acre): 6 lb DNBP amine, 4 and 6 lb CDAA, 6 lb CDAA-S (solventless), 2 lb monuron, 2 and 4 lb neburon, 8 lb CIPC, and 4 and 8 triethylamine salt of 3-amino-2,5-dichlorobenzoic acid (Amoben M-729). In addition 4 and 8 lb/A granular CDAA were applied dry. Each of the liquid herbicides was applied at 30 psi pressure in 40 gpa of water. Plots were 4′ wide and 16½′ long; treatments were replicated four times. Air temp at the time of herbicide application was 68° F, humidity 98% and soil wet. Rainfall totaled .80″ on May 4, 1.57″ on May 5 (herbicides were applied between showers on May 5) and .49″ on May 6. Air temp for the week preceding herbicide application averaged 65° F and for the week following 51° F. Weed control and bean injury ratings were taken 6 weeks after herbicide application. Weeds consisted of 70% *Amaranthus* spp., 20% *Portulaca oleracea*, 5% miscellaneous broad-leaved weeds and 5% annual grasses. Eight lb Amoben M-729 and 8 lb granular Amoben M-728 gave 100% weed control, and 4 lb Amoben M-729, 4 lb granular Amoben M-728, and 2 lb monuron gave 70 to 90% weed control. All other treatments gave less than 50% weed control. No herbicide tested injured beans except 8 lb Amoben M-729 and 8 lb granular Amoben M-728 which caused only slight injury. (Paper No. 4230 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Pre-emergence weed control in carrots grown on peat, 1959. Nylund, R. E.; Nelson, D. C.; Dinkel, D. H. and Weaver M. L. Nantes carrots seeded ½″ deep in peat soil on April 20 were sprayed on April 27 with the following herbicides (rates per acre): 1.6 lb monuron, 2 and 4 lb 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine (Trietazine, G-27901), 2 and 4 lb 2-chloro-4-diethylamino-6-isopropylamino-*s*-triazine (G-30031), and 4 and 8 lb triethylamine salt of 3-amino-2,5-dichlorobenzoic acid (Amoben M-729). Herbicides were applied to each of four replicates at 30 psi pressure in 40 gpa of water to plots 4′ x 16½′. The temp at the time of herbicide application was 50° F and the soil surface was dry. The first rain occurred 8 days after spraying on May 4 when .80″ rainfall was recorded, followed by 1.57″ on May 5 and .49″ on May 6. The temp for the week following spraying averaged 64° F. No weeds emerged until 2 to 3 weeks after spraying. Weed control and carrot injury ratings were recorded 7 weeks after spraying, by comparing each treated plot with an adjacent untreated plot. Weeds consisted of 90% *Amaranthus* spp, 5% miscellaneous broad-leaved weeds and 5% annual grasses. Four lb G-30031 and 8 lb Amoben M-729 gave 80-90% weed control without injuring carrots. Four lb Trietazine and 1.6 lb monuron gave 70% weed control but caused moderate to severe injury to carrots. All other herbicides gave unsatisfactory weed control but did not injure carrots. (Paper No. 4233 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Post-emergence weed control in carrots grown on peat, 1959. Nylund, R. E.; Nelson, D. C.; Dinkel, D. H. and Weaver, M. L. Nantes carrots seeded ½″ deep in peat soil on April 20 were treated on May 5 with 4 and 8 lb/A granular 3-amino-2,5-dichlorobenzoic acid (Amoben M-728) and on May 21 with the following liquid herbicides (rates per acre): 80 gal Stoddard solvent, 4 and 6 lb *N*-(3-chloro-4-methylphenyl)-2-methylpentanamide (N-4512), 4 and 6 lb *N*-(3,4-dichlorophenyl)methacrylamide (N-4556), 2, 4, and 6 lb *N*-(3,4-dichlorophenyl)--2-methylpentanamide (N-4562), and 2 and 4 lb 2-chloro-4,6-bis(isopropylamino)-*s*-triazine (Propazine, G-30028). Liquid herbicides were applied at 30 psi pressure in 40 gpa of water. Plots were 4′ wide and 16½′ long; treatments were replicated four times. On May 5, when the granulars were applied, carrots were in the one true leaf stage, no weeds had emerged, the temp was 68° F, and the soil surface very wet (1.57″ of rain just prior to application). The day following application .49″ of rain fell. Air temp for the week preceding herbicide application averaged 65° F and for the week following 51° F. On May 21, when the liquids were applied, carrots had 1-2 true leaves, weeds were in the cotyledon stage, the temp was 60° F and soil surface very wet (2.16″ of rain the previous day). On the day after spraying, .56″ of rain fell. Air temp for the week preceding spraying averaged 56° F and for the week following 62° F. Weed control and carrot injury ratings for all treatments were recorded on June 16. Weeds consisted of 90% *Amaranthus* spp. 5% miscellaneous broad-leaved weeds and 5% annual grasses.

All treatments gave better than 60% weed control but only 4 and 8 lb Amoben M-728, and 2 and 4 lb Propazine gave 90% to 100% weed control. No herbicide tested injured carrots except 8 lb Amoben M-728, which caused only slight injury. (Paper No. 4234 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Pre-emergence weed control in potatoes grown on peat, 1959. Nylund, R. E.; Nelson, D. C.; Dinkel, D. H. and Weaver, M. L. Red Pontiac potatoes planted in peat soil on May 5 were sprayed on May 21 with the following herbicides (rates per acre): 1.6 and 2.4 lb monuron, 6 lb CDAA, 2 and 4 lb simazin, 2 lb 2,4-D (alkanolamine salts of the ethanol and isopropanol series), 6 lb DNBP amine, and 2 lb 2,4-D (alkanolamine salts of the ethanol and isopropanol series) plus 10 lb TCA (Na salt). In addition one granular herbicide, 6 lb DNBP granular (M-1498) was applied dry. The liquid herbicides were applied at 30 psi pressure in 40 gpa of water. All herbicides were applied to single row plots 16½′ long in each of four replicates. At the time of herbicide application the soil was wet (2.16″ of rain the previous day), the air temp was 60° F and a few weeds but no potatoes had emerged. The day following application .56″ rain was recorded and during the week following application temp averaged 62° F. Weed control and potato injury ratings were recorded 26 days after herbicide application. Weeds consisted of 70% *Amaranthus* spp. 10% miscellaneous broad-leaved weeds, and 20% annual grasses, mostly *Setaria* spp. Yields were recorded on September 9. The following herbicides gave commercially acceptable weed control: 1.6 and 2.4 lb monuron, 2 and 4 lb simazin, 2 lb 2,4-D, and 2 lb 2,4-D plus 10 lb TCA. Only one herbicide, 4 lb simazin, caused moderate injury to potato plants and significantly reduced yield of tubers. (Paper No. 4235 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Pre-emergence, post-emergence, and pre-planting herbicidal treatments for red beets on upland soil. Rake, Leo and Holm, LeRoy. Detroit Dark Red beets were planted in a moist Miami silt loam soil on May 12 in a replicated, randomized block experiment. Pigweed, purslane, and green foxtail were the predominant weeds in the area. During seven days following planting 2.3 inches of rain fell. Herbicides were applied on the day of seeding. Stand counts of weeds and beets, and weights of weeds by species were recorded four weeks after seeding. Yields were obtained in late July from plots which had been cultivated and hand-weeded for the entire season. The effect of the herbicides on the weeds was studied in areas adjacent to the crop within each replicate. The following herbicides were used with rates in lb/A: disodium salt of endothal, 6 and 8; the sodium salt of TCA, 8; EPTC, 6; CDEC, 6; dalapon, 8; neburon, 4; Carbyne (4-chloro-2-butynyl *N*-(3-chloro-phenylcarbamate), 6; and Amoben (3-amino-2,5-dichlorobenzoic acid as triethylamine salt) 4.

SUMMARY: Amoben and neburon eliminated most of the beet stand but showed excellent control of all weeds at rates used. Dalapon and Carbyne were very harmful to the beets. Significant reductions in the weight of pigweed were caused by the following herbicides (in the percentages indicated in parentheses): endothal 8 lb/A (69); TCA 8 (34); CDEC 6 (75); EPTC 6 (47); dalapon 8 (63). Stands of purslane were reduced significantly by the following herbicides: endothal 6 (66) and 8 (66); EPTC 6 (90); CDEC 6 (67); and Carbyne 6 (66). The

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stand of grassy weeds was controlled as follows: endothal 8 (40); TCA 8 (100); dalapon 8 (98); EPTC 6 (100); CDEC 6 (84); and Carbyne 6 (32).

In addition, in adjacent replicated experiments, 3 post-emergence sprays were applied to separate plots at weekly intervals beginning two weeks after seeding. The herbicides were endothal 6, TCA 8, Amoben 4, dalapon 5, and Carbyne 6 lb/A. Endothal was most effective in controlling weeds, and though it gave the least injury to the beets, sufficient harm was done that this must be viewed as an emergency treatment only.

During the same period, and on the same soil type, pre-planting treatments of TCA 8, endothal 8, EPTC 3 and 6, IPC 3, and CDEC 8 lb/A were incorporated into the soil. The following combinations were used similarly: TCA 8 with CDEC 4, TCA 8 with endothal 4, and endothal 4 with CDEC 4 lb/A. The crop was planted immediately following the treatments. Data were recorded only on the tolerance of the beets. Only EPTC (at both rates) and the combination of TCA with endothal caused serious injury to the beets. Reductions in yield were of the order of 35%. (Contribution of Department of Horticulture, Wisconsin Agr. Exp. Sta.)

FLOWERS

Post-planting weed control in garden chrysanthemums, 1958 and 1959. Widmer, R. E. and Stadtherr, R. J. Plants of Wanda variety were planted on June 16, 1958, and June 24, 1959, and the plots were selectively treated with herbicides 8 days later. In 1958, the following herbicides were applied (rates, lb/A) as sprays: 0.25 simazine; 10 EPTC; 0.8 diuron; 0.4 diuron + 3.6 sesone; 0.8 monuron; 3 and 8 CIPC; 4 CDAA; 0.4 diuron + 3.7 dalapon; 2 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine (Trietazine, G-27901); 2 2-chloro-4-diethylamino-6-isopropylamino-*s*-triazine (G-30031); and 2 and 6 tris(2,4-dichlorophenoxyethyl) phosphite (3Y9). The following granular herbicides were also applied: 10 EPTC, 8 CIPC, 4 CDAA and 6 3Y9. In 1959, the following herbicides were applied as sprays: 0.8 diuron; 3 neburon; 3 CIPC; 4 CDAA; 2 G-30031; 3 and 6 sodium salt of 2,3,6-trichlorophenylacetic acid (M-673A); 3 triethylamine salt of 3-amino-2,5-dichlorobenzoic acid (Amoben, M-729); 4 3-nitro-2,5-dichlorobenzoic acid (M-503); 2 lb *N*-3,4-dichlorophenyl)-2-methyl pentanamide (N-4562); 4 dimethyl 2,3,5,6-tetrachloroterephthalate (D-893); 6 CDEC; and 15 lb *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron, M-1329). The following granular herbicides were also applied: 0.8 diuron; 3 neburon; 8 CIPC; 4 CDAA; 3 and 6 3-amino-2,5-dichlorobenzoic acid (M-728); and 15 Zytron, M-1481. All plots contained four plants, were 3 ft wide and 8 ft long and each treatment was replicated four times. Sprays were applied at 30 psi in 120 gpa water with a flat spray nozzle. On June 24, 1958, 0.24 in. of rain fell in the morning but the sun was shining in the afternoon when application was made. Soil temp 2 in. below the surface was 68° F. The mean temp for the 6-day period prior to application was 63° F. and ppt totaled 0.25 in. The mean temp for the 6-day period following June 24 was 70° F. and ppt totaled 0.07 in. On July 1, 1959, the weather was sunny and the soil temp 2 in. below the surface was 67° F. The mean temp for the 6-day period prior to July 1 was 65° F. and ppt totaled 1.40 in. The mean temperature for the 6-day period following July 1 was 68° F. and ppt totaled 4.02 in. Weeds present in 1958 were primarily purslane, a limited population of dandelion, and scattered grasses. In 1959, a different field was used, in which weeds consisted primarily of witchgrass, purslane, redroot pigweed, and prostrate pigweed. Injury ratings and weed counts were taken in a 6 sq ft area in the center of each plot on August 13, 1958 and August 17, 1959. In 1958, excellent weed control was obtained with 8 CIPC spray and granular and 2 G-30031 spray. Good weed control was obtained with the following sprays: 0.4 diuron + 3.6 sesone; 0.8 monuron; 3 CIPC; 6 3Y9; and 6 granular 3Y9. Fair weed control was obtained with the following sprays: 0.4 diuron + 3.7 dalapon; 2 G-27901; and 2 3Y9. In 1959, 3 and 6 M-673A provided excellent weed control, but the chrysanthemum plants were injured. Fair weed control was obtained with the following granular herbicides: 8 CIPC; 6 M-728; and 15 Zytron. (Paper No. 4249 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

TURF

Effects of Fenac foliage spray on creeping red fescue and Kentucky bluegrass in the field. Corns, Wm. G. Duplicate plots of 2-year-old Kentucky bluegrass and 1-year-old creeping red fescue were sprayed on July 11, 1959 with 0, 5, 15, and 30 lb/A of Fenac (2,3,6-trichlorophenylacetic acid), liquid sodium salt formulation, and of an acetamide wettable powder formulation, in 30 gal /A water. Visual assessment in late July and August indicated no appreciable effect on fescue of the acetamide formulation, but some burning from 15 and 30 lb/A rates of the sodium salt. Kentucky bluegrass, somewhat more sensitive than fescue, showed moderate burning from 15 lb. and pronounced foliage injury from 30 lb/A acetamide. There was slight to severe burning from the 5 to 30 lb/A rates of the sodium salt. Survival of undisturbed couch grass from 30 lb/A Fenac, noted in another abstract, makes it doubtful that Fenac will prove satisfactory for selective control of this weed in turf. (Division of Crop Ecology, Dept. of Plant Science, Univ. of Alberta).

Herbicide treatments for nimblewill control. Herron, J. W. Post-emergence applications of MH at 5 and 10 lb/A and Zytron (*O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate, on vermiculite and emulsifiable concentrate) at 10, 15, 20, and 30 lb/A were made on turf containing nimblewill and Kentucky bluegrass. Dates of treatment were July 7, July 27, August 10, and August 31, 1959. Visual ratings of injury were made on September 9, 1959. MH at each rate caused severe injury to nimblewill and moderate to severe injury to the bluegrass. Little, if any, bluegrass injury was noted on any of the Zytron treated plots. Treatments with Zytron at 10 and 15 lb/A had very little effect on nimblewill. Treatments at 20 and 30 lb/A of emulsifiable Zytron gave variable results on nimblewill, ranging from no apparent injury to severe injury. Date of application did not consistently affect plant response to the material. Zytron on vermiculite at any rate caused very little, if any, injury to either the bluegrass or nimblewill. These results indicate that only the emulsifiable concentrate holds much promise, and rates higher than 30 lb/A may be included in additional tests. Since nimblewill is a perennial, observations on regrowth in the spring of 1960 will be made. (Contribution of Department of Horticulture, Univ. of Kentucky Agr. Exp. Sta.)

Pre-emergence herbicides for crabgrass control. Lee, O. C., Jacobson, A., and Rogers, B. J. A golf course fairway was treated April 14, 1959, before crabgrass emergence. Crabgrass control was estimated by percent infestation on Aug. 24. Chlordane at 75 lb/A and the arsenates at 400-700 lb/A continued to give excellent control. Granular arsenates varied in effectiveness, depending on the manufacturer. It was found that a year after an initial treatment with 75 lb/A chlordane, a booster shot of about 40 lb/A is necessary to maintain control. Dimethyl 2,3,5,6-tetrachloroterephthalate at 7.5 and 10 lb/A was as effective as the chlordane and arsenate. Sodium 2,3,6-trichlorophenylacetate at 1, 2, and 4 lb/A; *O*-2,4-dichlorophenyl *O*-methyl isopropylphos-

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phoramidothioate at 10 and 20 lb/A; and diphenylacetonitrile and (*p*-chlorophenyl)phenylacetonitrile at 4, 8, and 12 lb/A were not particularly effective. (Dept. of Bot. and Plant Path., Purdue Univ. Agr. Exp. Sta.)

Early pre-emergence crabgrass control, 1959. Stadtherr, R. J. Sixteen different herbicides were applied on May 7, 1959 to plots containing Highland bent, Astoria bent, Park Kentucky bluegrass, commercial Kentucky bluegrass, redtop, rough-stalked bluegrass, Chewings fescue and creeping red fescue. Each treatment was replicated three times. The following liquid herbicides were applied at 30 psi at about 110 gal/A at rates indicated in g/1000 sq ft: dimethyl 2,3,5,6-tetrachloroterephthalate (DAC-893) 52.1; 2,3,6-trichlorophenylacetic acid (M-673A) 62.5; sodium 2,3-dichloroisobutyrate (FW-450) 452; diphenylacetonitrile (L-13489) 83.5; (*p*-chlorophenyl)phenylacetonitrile (L-09726) 83.5; *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron, M-1329) 232.5; and neburon 41.7.

The dry or granular materials were applied with a lawn spreader. Amounts are given for 1000 sq ft: lead arsenate 20 lb; (L-13489) 167g; (L-09726) 167g; *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron, M-1481) 208.4g; lead arsenate + chlordane + fertilizer (PAX) 25 lb; calcium arsenate + fertilizer (FB-1) 35 lb; calcium arsenate (AC) 12 lb; calcium arsenate (CC) 12 lb; and chlordane (Halts) 10 lb. The lead arsenate, PAX, FB-1, calcium arsenates, and Halts are given in total amount per 1000 sq ft.

The 6-day period before application had a mean temp of 69° F with a total of 2.25 in. rain. On May 6, 1.33 in. of rain fell. The mean temp on May 7 was 49° F. The mean temp for 6-day period following application was 56° F with .56 in. rain. The ppt was 3.47 in. for May, 4.76 in. for June, 2.75 in. for July and 6.06 in. for August. All plots were given 1 in. irrigation on July 24. The soil was a clay loam, low in organic matter and nitrogen. All plots were sprinkled lightly just after applications were made. Plots treated with FW-450 showed much turf injury to all grasses two weeks later. M-673A and M-1329 showed a slight burn on all grasses. First flush of both large and small crabgrass emergence was observed on June 7 about a week after a 1.13 in. rainfall. The mean temperature averaged 73° F six days before crabgrass was seen.

The following herbicides gave satisfactory commercial crabgrass control for the season: DAC-893 93%, lead arsenate 99%, Zytron M-1329 100%, Zytron M-1481 97%, PAX 96%, FB-1 90% and CC 91%. Permanent turf injury on all grasses was observed with FW-450. Injury was heavy with permanent damage with M-673A on the rough-stalked bluegrass, fescues and bents. Although Zytron M-1329 showed an initial injury to all turf types, the turf in these plots was as green for the remainder of the season as the turf which had treatments that contained fertilizers. (Paper No. 4260 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Post-emergence crabgrass control, 1959. Stadtherr, R. J. Sixteen post-emergence herbicides were used to control large and small crabgrass in a predominantly Kentucky bluegrass lawn. The treatments, rate of application, number of applications and percentage of control are given in the table. New herbicides which were included were: *n*-butyl 2-propoxybenzoate (U-9613), octyldodecyl ammonium methyl arsonate (AMA), 2,3,6-trichlorophenylacetic acid (M-673A), diphenylacetonitrile (L-13489), (*p*-chlorophenyl)phenylacetonitrile (L-09726) and *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate (Zytron or M-1329). All liquid herbicides were mixed with water using 110 gal/A and were applied at 30 psi.

Quadruplicate plots were set up with two replicates in a regularly irrigated area while the other two were in a non-irrigated area. The crabgrass at the time of the first application of herbicides on July 21 was 2 in. tall and just starting to branch at the base. There was no rain during the week just preceding the first application. On the evening of July 21, 0.16 in. fell. The second applications were made on July 28. No rain fell from July 21 until the evening of July 28 when 0.27 in. fell. On August 2, 0.4 in. fell which was the only rain through August 4 when the last applications were made. A total of 1.89 in. fell in the following week. The temp means for the six days prior to each application date were 71° F, 76° F and 77° F respectively. The week following the last application had a mean of 72° F. The temp during the applications were 84, 83, and 85° F, respectively.

The results on September 18, 1959 are summarized in the table. Treatments with a crabgrass control rating of 2.5 or less are considered to be satisfactory. Injury to bluegrass was rated on July 27 and the following treatments showed considerable damage to the bluegrass: DSMA (49.5g), AMA, KOCN, KOCN + MCP, M-673A + DSMA, Zytron + DSMA and U-9613 + DSMA. When final ratings and counts were made only KOCN + MCP and AMA showed permanent damage to bluegrass.

Herbicides	Rates per 1000 sq ft grams	No. of weekly appl.	Percent control[1] Wet	Dry	Rating[2] crabgrass control
DSMA	49.5	3	99	80	2.5
KOCN+MCP	75.3+14	3	77	71	3.8
Neburon	15.2	1	34	21	7.5
AMA	68.2	3	100	99	1.3
U-9613	160	2	39	72	5.5
M-673A	41.7	1	34	8	8.0
KOCN	75.5	3	66	50	5.3
PMA	9.5	3	50	95	3.5
L-13489	83.5	1	0	26	8.3
L-09726	83.5	1	19	49	7.5
M-1329	156	1	48	0	7.8
DSMA	23.6	1	89	13	5.5
Check	....	0	0	0	9.0
M-673A+DSMA	4.2+49.5	1	0	81	6.3
U-9613+DSMA	160+ .7	1	100	93	1.5
M-1329+DSMA	156+49.5	1	100	95	1.5
Neburon+DSMA	15.2+49.5	1	49	91	4.5

[1]Wet=irrigated lawn; dry=non-irrigated lawn

[2]Ratings are 9=no control or injury to 1=Complete kill (Paper No. 4259 of the Scientific Journal Series of the Minnesota Agr. Exp. Sta.)

Pre-emergence crabgrass control in bluegrass turf with O-2-4,-dichlorophenyl O-methyl isopropylphosphoramidothioate (Zytron). Watson, A. J. and Leasure, J. K. During 1957 to 1959 one or more experiments have been conducted with Zytron in each of several areas, including Michigan, Ohio, Indiana, Minnesota and Washington, D.C., for the selective control of crabgrass in established bluegrass turf. Used in the spring prior to crabgrass germination, excellent control for the season has been obtained consistently with rates of 15 to 20 lb/A. Granular and emulsifiable formulations have been equally effective on both smooth crabgrass and large crabgrass.

Merion and Kentucky bluegrass are especially tolerant to Zytron and rates as high as 60 lb/A have been used without permanent injury. Red fescue, bentgrasses and white clover are less tolerant and usually exhibit slight to rather severe temporary injury, particularly from emulsifiable formulations.

Zytron should not be used on new seedings. However, areas treated in the spring can be reseeded where necessary in late summer or fall. (Contribution of the

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Agricultural Chemical Research Department, The Dow Chemical Company).

Response of crabgrass to post-emergence applications of O-2,4-dichlorophenyl O-methyl isopropylphosphoramidothioate (Zytron). Watson, A. J. and Leasure, J. K. Several post-emergence applications have been made to crabgrass in established bluegrass turf during 1957 to 1959. The stage of growth at time of treatment has varied from emergence to maturity. The results may be summarized as follows: The resistance of crabgrass to Zytron increases rapidly following germination. Until it reaches the early 2-leaf stage or about ½ inch in height it is usually controlled satisfactorily with 20 lb/A either as a granular applied dry or as an emulsifiable applied as a spray.

Crabgrass beyond the 2-leaf stage is normally not affected by granular formulations. Sprays applied at 30 to 40 lb/A cause marked selective contact burns of crabgrass but often regrowth occurs from the crowns. Results have been generally poor to only fair from mid-season treatments.

Late summmer and early fall treatments of 30 to 40 lb/A applied during the period of seed germination, have resulted in the production of non-viable seeds and have given good to excellent control the following season.

Post-emergence sprays applied at the rate of 20 lb/A have given excellent control of common and mouse-eared chickweed and have shown promise for the control of nimblewill. Granular applications have been relatively ineffective post-emergence on these species.

Spray applications of 30 to 40 lb/A usually cause slight to moderate temporary leaf burn of bluegrass but cause moderate to severe injury to red fescue, bentgrasses and white clover. (Contribution of the Agricultural Chemical Research Department, The Dow Chemical Company).

BASIC STUDIES

Relative residual phytotoxicity of simazin and 2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine (Atrazine). Behrens, R. Simazin and Atrazine applications of 0, 2, 6, and 12 lb/A were applied to a Waukegan silt loam soil on November 14, 1958 at St. Paul, Minnesota in triplicated plots of 1 x 2 rods. Each plot was sown to flax, wheat, and oats on April 30, 1959 and soybeans on May 27, 1959. Percentage kills of flax, wheat and oats, and of broadleaf (mostly *Amaranthus retroflexus*) and grass (mostly *Setaria* spp.) weeds were estimated on May 29, 1959 and of soybeans on August 13, 1959. Percentage kill estimates of crops and weeds treated with 2, 6, and 12 lb/A of simazin were 27, 77, and 100 for flax; 67, 80, and 100 for wheat; 60, 97, and 100 for oats; 0, 90, and 100 for soybeans; 63, 70, and 87 for broadleaf weeds; and 50, 70, and 87 for grass weeds, respectively. Percentage kill estimates of crops and weeds treated with 2, 6, and 12 lb/A of Atrazine were 33, 73, and 83 for flax; 83, 100, and 100 for wheat; 93, 100, and 100 for oats; 37, 100, and 100 for soybeans; 70, 87, and 90 for broadleaf weeds; and 60, 87, and 90 for grass weeds, respectively. The results indicate that the phytotoxic effect of Atrazine was greater than that of simazin six months after treatment. When these plots were observed in September, heavy weed growth of *Digitaria ischaemum*, *Amaranthus retroflexus* and *Setaria* spp. had developed on all except those treated with 12 lb/A of both compounds. Approximately 50% of the plot areas were covered with weed growth when either compound had been applied at 12 lb/A. This indicates that the residual phytotoxicity of Atrazine and simazin was approximately the same 10 months after the applications had been made.

(Contribution from the Department of Agronomy and Plant Genetics, Univ. of Minnesota, St. Paul. Paper No. 4253, Sci. Jour. Series. Minnesota Agr. Exp. Sta.)

Comparisons of wild oats, barley and wheat germinated in aqueous solutions of Avadex, Carbyne and Fenac. Corns, Wm. G. Wild oats, Parkland barley, and Thatcher wheat were kept for a week at 21° C. in the dark in repeated experiments in Petri dishes with 5 cc. of solution containing 0, 0.5, 1, 2, 5, 10, 20, 30, 40, 50, 100, and 200 ppm of Avadex (2,3,dichloroallyl diisopropylthiolcarbamate), and of Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate), and 0, 1, 2, 5, 10, 20, 50, 100, and 200 ppm Fenac, (2,3,6-trichlorophenylacetic acid). Concentrations in ppm of herbicides causing incipient, or complete, inhibition of shoot or root growth were:

	Avadex			Carbyne			Fenac		
	W.O.	W.	B.	W.O.	W.	B.	W.O.	W.	B.
Incipient									
Shoots	1	5	5	1	5	2	2	5	2
Roots	1	5	10	1	5	1	10	10	2
Complete									
Shoots	200	200+	200+	30	200	200	200+	200+	200+
Roots	100	200+	200+	20	200	40	100+	200+	10

Differential selectivity between herbicides, species, shoots, and roots was indicated. In particular the small amount of Carbyne required for complete inhibition of wild oats suggested studies of formulations of this herbicide as soil treatments. (Division of Crop Ecology, Dept. of Plant Science, University of Alberta).

Variable dormancy of wild oat varieties. Sexsmith, J. J. A careful separation of four varieties of wild oats was made from a sample collected near High River in the fall of 1958. Blotter germination tests were made on February 10 and 20, and the combined results of these tests, having a minimum of 270 seeds for each variety, are given below:

Avena fatua var.	Hull color	Callus hairs	Percent germination
vilis	grey	short	45.5
glabrata	grey	long	42.1
intermedia	brown	short	18.9
pilosissima	brown	long	11.6

The two brown-hulled varieties were considerably more dormant than the grey-hulled varieties. When the dormant seeds were de-hulled and the seed coats pricked, it was found that seed of all four varieties were 100% viable. (Canada Agriculture, Research Station, Lethbridge, Alberta.)

Relationship between hull color and dormancy in wild oats. Sexsmith, J. J. Between August 28 and September 12, 1958, seed samples of wild oats were collected at nine locations in southern Alberta. All but collections 3 and 9 were made from standing plants, and these two were collected from soil surface on September 10 and 12 and assumed to have been on the ground no more than three weeks. The collections were carefully hand picked in an effort to save only mature primary seeds, and an estimate of the percentage of grey- and brown-hulled seed was made for each collection. Blotter germination tests of 100-seed lots were made at 7-week intervals from September 18, 1958, to April 1, 1959. Minimum viability of all collections was determined to be 99%. Results of tests are given in the following table:

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Pct. grey hulls	No.	Germination percent, 1958-59				
		Sept. 16	Nov. 4	Dec. 23	Feb. 11	April 1
100	8	42	98	95	98	98
95	3	47	71	85	77	91
95	7	16	56	65	56	75
90-95	9	3	29	26	19	53
90-95	6	7	35	43	57	45
50	1	86	97	98	100	100
10	5	6	40	59	57	81
0	4	3	20	48	44	52
0	2	0	14	28	35	30

The majority of the collections show a relationship between hull color and germinability, grey hull color being associated with low dormancy and brown hull color being associated with a high degree of dormancy. (Canada Agriculture, Research Station, Lethbridge, Alberta.)

NURSERIES AND SHELTERBELTS

Control of grass growing under ash trees. McCurdy, E. V. Some herbicides were applied to crested wheatgrass growing under ash trees in 1957, to a new group of plots in 1958, and another group in 1959. In 1957 dalapon at 15 lb/A resulted in excellent control of the grass with no injury to the trees. Dandelions increased with the removal of the grass. In 1958 the trees were slightly injured by 15 lb/A and quite severely injured by 20 lb/A. With similar rates in 1959, under very dry conditions in the early part of the season, injury to the trees was not apparent but following heavy rains later, injury appeared. Grass control was excellent. The trees were quite severely injured by a mixture of dalapon at 15 lb/A and amitrol at 8 lb/A but again the grass and other weeds were controlled. From the experience in the past 3 years it does not appear too safe to use dalapon to control grass under ash trees at Indian Head. Amitrol applied in 1958 at 4, 8, and 12 lb/A controlled grass and dandelions at the heavier rates but considerable regrowth had occurred by the fall of 1959. The trees were uninjured. With 8 and 12 lb/A, similar results were noted in 1959. Amitrol plus ammonium thiocyanate (Amitrol-T) was not effective at 2 lb/A but gave some control at 4 lb/A without injury to the trees. Spruce were not injured by the light rate of dalapon or the 8 lb/A rate of amitrol. (Contributed by the Experimental Farm, Indian Head, Saskatchewan).

WOODY PLANTS, RIGHTS-OF-WAY, AND INDUSTRIAL SITES

Brush control with various herbicides and their mixtures. Corns, Wm. G. Two experiments with mixed vegetation of sand-dunes at the Woodbend Ecology Field Station near Devon, Alberta, involved foliage sprays of duplicate 200 sq ft areas for each treatment. Expt. I: 2,4-D ethyl ester, 2 lb/A; 2,4,5-T isooctyl ester mixed with 2,4-D ester, 1 lb/A each; silvex, propylene glycol butyl ether ester, 2 lb/A; Fenac, 2,3,6-trichlorophenylacetic acid, sodium salt, 2 lb/A; silvex with 2,4-D, Fenac with 2,4-D, Fenac with silvex, at 1 lb/A each in each mixture; in 30 gal/A water on June 16, 1959. Expt. II: The same herbicides as above including 2,4,5-T, all at 3 lb/A and in respective dual mixtures having 1½ lb/A each; on June 30, 1959. Progressive injury was rated visually using indices 0-6 corresponding to the classifications from resistant to very susceptible in the tabular summary.

Species	Response*			
	2,4-D	2,4,5-T	Fenac	Kuron
Amelanchier alnifolia (Saskatoon serviceberry)	VS	VS	IR	VS
Arctostaphylos uvaursi (Bearberry)	IR	IR	R	IR
Corylus cornuta (Hazelnut)	VS	VS	RI	VS
Lathyrus venosus (Veiny peavine)	VS	VS	VS	VS
Populus tremuloides (Aspen poplar)	IS	S	R	S
Prunus melanocarpa (Chokecherry)	SI	SI	RI	IS
Prunus pensylvanica (Pin cherry)	S	S	RI	S
Rosa sp. (Wild rose)	RI	VS	R	SVS
Symphoricarpos occidentalis (Snowberry)	IR	IR	R	IR

* R (Resistant), I (Intermediate), S (Susceptible), VS (Very susceptible), IR (Intermediate to resistant, but majority intermediate) etc.

There was insufficient regrowth to warrant decisive comparisons of root killing this year. 2,4-D-2,4,5-T mixtures appear to be at least equal to anything else. Fenac as sodium salt foliage spray was inferior. (Division of Crop Ecology, Dept. of Plant Science, University of Alberta).

Responses of caragana to various herbicides. Corns, Wm. G. An old caragana hedge about 12 feet tall, bordering a field was used in the summer of 1958 for comparisons of sprays of 2,4-D butoxyethanol ester and 2,4,5-T iso-octyl ester at 2 and 4 lb/A; soil treatments with 2,4-D granular (Monsanto) at 8 lb/A and fenuron pellets at 6 lb/A; ammonium sulfamate (Ammate) spray at 50 lb/A; dalapon spray at 15, 30, and 60 lb/A; all sprays in 100 gal/A water. The 2,4-D and 2,4,5-T treatments were applied to intact plants and to stumps about 1 foot high, having 2 weeks' regrowth after cutting. By fall of 1959 it seemed clear that 2,4,5-T was much more effective than 2,4-D and that results from spraying of intact plants were greatly superior to those for cut plants. Both rates of 2,4,5-T prevented leafing the following spring but there were some new basal shoots by fall of 1959. The 60 lb/A rate of dalapon was very effective with virtually no regrowth of caragana by fall 1959. The use of 2,4,5-T with repetition, if required, seems to be the most practical eradicant. The granular 2,4-D, fenuron pellets, and Ammate were ineffective. (Division of Crop Ecology, Dept. of Plant Science, University of Alberta).

Effect of chemical treatment of girdles on red maple. Day, Maurice W. Two groups of 80 red maple trees varying from 2" to 10" dbh were girdled at 4 ft with a power girdler. The first group was girdled in the winter and treated in July, and the second group was girdled in July and treated the same day. Undiluted formulations were applied to the girdle with a medicine dropper at the rate of 1 ml per inch of diameter. Fourteen months later the treatments were evaluated. The first group did not appear to show any appreciable differences between the various treatments and the control. The second group showed the following differences:

Treatment	Effectiveness per cent
Amitrol 2 lb/gal	88
1 lb amitrol plus 4 lb PBA amine salt/gal	86
2,4-D amine salt (ethanol and isopropanol series), 4 lb/gal	64
2,4,5-T triethylamine salt, 4 lb/gal	72
2,4,5-T propylene glycol butyl ether ester, 4 lb/gal	84
2,4,5-T propylene glycol butyl ether ester, 2 lb/gal	40
2,4,5-T butoxyethanol ester, 4 lb/gal	84
Control, no herbicide	52

Percent of effectiveness based on 100% equaling a complete kill of the tree top. (Contribution of Michigan Agr. Expt. Sta., E. Lansing.)

Multiflora rose control with herbicides. Fletchall, O. Hale and Talbert, Ronald E. As more Multiflora rose hedges are established for fence and for wildlife cover, the problem of plants invading areas where they are not wanted is increasing. This plant does not spread into areas that are plowed occasionally, nor to any appreciable extent into open pasture land. It does spread, sometimes rather badly, into areas near trees, fences, or power and telephone lines where birds perch.

Repeated foliage sprays using 2½, 5, and 10 lb ahg of 2,4,5-T propylene glycol butyl ether (PGBE) ester in water were more effective than 2,4-D PGBE ester, silvex PGBE ester, 2,3,6-TBA dimethylamine, or amitrol. After 3 annual treatments with 2,4,5-T the defoliation was 98%, and 92% of the plants were killed.

Monuron at 5.2 g/plant (about a tablespoonful of 80% material) was about equal to 8 g/plant of sodium *N*-methyldithiocarbamate (Vapam), and much more effective than 5.2 or 10.4 g/plant of simazin when applied to the soil at the base of each plant. Monuron performed equally well when applied as a dust or as a water suspension.

It required 20.8 g/plant of 2,3,6-TBA to give an 87% kill while 10.4 g/plant of monuron gave a 90% kill.

In general, monuron and 2,3,6-TBA soil treatments gave better kills on small plants than on large ones. With the rate determined on the basis of a certain amount of herbicide per plant, they were also more effective where the Multiflora rose stands were thick enough so that the root system of one plant could pick up material applied to nearby plants as well as that applied to it. (Contribution of the Missouri Agr. Exp. Sta.)

Soil sterilants for parking areas, 1959. Selleck, G. W. A CBM (Polybor-chlorate, 25% sodium chlorate, 49% boron trioxide) at 2, 4, and 8 lb/100 sq ft, a BMM (Ureabor, 4% monuron, 45.4% boron trioxide) at 1, 2, and 4 lb/100 sq ft, fenuron at 25, 50, and 100 lb/A and monuron at 50 lb/A were applied to 10 x 10 sq ft plots in parking areas on north and south sides of the gymnasium, U. of S. Campus, April 29, 1957. About 1 in. of gravel was applied to the area one month after application. Fenuron at 50 lb/A was applied to the entire east side of the building. The percentage control of all growth Sept. 1959, is presented below.

Herbicide	Rate lb/100 sq ft	Per cent control	
		South side	North side
CBM	2	75	75
CBM	4	90	90
CBM	8	95	99
BMM	1	100	95
BMM	2	100	99
BMM	4	100	100
	lb/A		
Fenuron	25	50	99
Fenuron	50	90	95
Fenuron	100	100	100
Monuron	50	50	99

Weed control was usually better on the north side of the building than on the south side, and fenuron at the 50 lb/A rate maintained 100 percent control along the east side. (Contribution No. 277 from the Dept. of Plant Ecology, Univ. of Saskatchewan, Saskatoon, with financial assistance from the Sask. Agric. Research Foundation.)

Soil sterilants on annual and perennial weeds. Stroube, E. W. and Bondarenko, D. D. Triplicate square-rod plots on a railroad right-of-way infested with quackgrass, nimblewill, curled dock, dandelion, field bindweed, hedge bindweed, wild carrot, buckhorn plantain, smartweed, pigweed, crabgrass, barnyardgrass and various species of clover were treated by various herbicides on May 15, 1959. All herbicides were applied in 160 gpa water except a CBMM (Chlorea, 40% sodium chlorate, 57% sodium metaborate, 1% monuron), which was applied dry. The ratings on September 24, 1959, are presented in the table.

Herbicide	Rate, lb/A	Rating* of effect of herbicide on plants
Diuron	40	9.8
Diuron plus Trysben (dimethylamine salts of polychlorobenzoic acids)	25 + 8	9.5
Chlorea	1 lb/100 sq ft (as sold)	9.3
Erbon (Novon)	2 qt/sq rd (as sold)	8.7
Simazin	10	8.0
Simazin plus amitrol	8 + 2	7.5
Atrazine (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine	10	7.3

* Rated on basis of 0 = no effect, 10 = all plants killed.

The plots treated by diuron, diuron plus Trysben, and Chlorea showed only a few bindweed and/or quackgrass plants. The other plots were infested by three or more of the weed species mentioned. (The Ohio Agr. Exp. Sta.)

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SUMMARY OF NEW RESEARCH FINDINGS

Prepared by the Research Committee

NORTH CENTRAL WEED CONTROL CONFERENCE

(Supplement to Research Summaries, NCWCC, 1958)

FOREWORD

The information presented in this report has been prepared by members of the Research Committee of the North Central Weed Control Conference. It is based on brief research reports submitted to the Editor, NCWCC, and on information obtained by correspondence with persons carrying on research in the particular field of endeavor.

This material is to be used as a supplement to the extensive research summaries prepared by the Research Committee in 1958. It represents new and for most part promising research findings of the 1959 season, but is not to be construed as constituting a recommendation by the Committee or the Conference. This material is presented as background information for research workers and persons responsible for making recommendations for the control of weeds.

The use of chemicals mentioned in this report is contingent upon registration by the United States Department of Agriculture and/or establishment of residue tolerances where necessary by the United States Department of Health, Education and Welfare. Chemicals should be used only as recommended on the label. Persons making recommendations for uses beyond those indicated on the label may be held liable.

The rates of application given for 2,4-D, MCPA, 2,4,5,-T, and dalapon are on the basis of acid equivalent; the rates of PCP and DNBP refer to the phenol equivalent and the rates of PMA, IPC, CIPC, monuron, MH, sesone, NPA and KOCN refer to the active ingredients.

Research Committee,

North Central Weed Control Conference
Delbert D. Hemphill, Chairman
George F. Friesen, Vice-Chairman.

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BASIC STUDIES IN BOTANY, ECOLOGY AND PLANT PHYSIOLOGY

B. J. Rogers

The four reports submitted were so diverse as to illustrate three major problem areas in weed control research. Two of the reports concerned dormancy and germination of wild oat seed as related to hull color; brown hulled varieties were more reluctant to germinate than were those with gray hulls. These reports add to the considerable amount of knowledge we now possess on the superficial characteristics of weed seed germination. We have data on a number of phenomena related to germination, such as hull color, seedcoat thickness and permeability, temperature, endogenous inhibitors, and the nitrate effect, and we have numerous examples of weed seeds which illustrate these phenomena; with this background it is time, perhaps, to delve experimentally into the intimate details of weed seed germination.

A third report covered the action of three herbicides on seedling growth of wild oats, barley and wheat. The variability in response between species, and between root and shoot growth, points to another major project for future research. As yet, with the exception of the work with the butyric acid analogs of 2,4-D, we have little if any basis for understanding the reasons for biochemical selectivity as shown by herbicides. Admittedly this is a difficult problem, and perhaps additional preliminary data must be collected. For instance, it would be helpful to determine the gross response of plant parts of various species of weeds to an analogous series of any one herbicide; from the gross response we might proceed to an examination of the cellular response, and then to the intracellular level. This has been done for 2,4-D; it should be done for the other important herbicides.

Finally, a report on the residual toxicity in the soil of simazin and the related triazine, 2-chloro-4-ethylamino-6-isopropylamine-*s*-triazine (Atrazine) was submitted. Both persisted in a silt loam soil for at least six months at 2 lb/A and over ten months at 12 lb/A. This soil residue problem concerns not only pre-emergence chemicals such as the triazines, but all chemicals applied to the soil. The soil is such a complex entity that it is difficult to establish the bases on which depend long or short term residual action. Soil microbiologists are best equipped to study the contribution of microorganisms, but this is only one facet of the problem. The effect of climate and soil type is not yet clear, nor do we understand even the basic question of when pre-emergence herbicides act in the soil; that is, do they act on the imbibed seed, or does the chemical enter only after the radicle or primary root has emerged? With the background we now have, all of these problems are amenable to experimental solutions.

CONTROL OF HERBACEOUS ANNUAL AND PERENNIAL WEEDS

Lyle A. Derscheid

Grassy Perennials

Johnsongrass *(Sorgum halepense* L.) Data reported in 1959 confirm earlier results indicating that EPTC incorporated into the soil at the rate of 3 to 4 lb/A kills seedlings. In one 1959 test, seedlings were killed with as little as 1½ lb/A with and without incorporation. In another case, a 6 lb/A rate killed 90% of the old plants. Johnsongrass was mowed when the seed was in the dough, and the chemical was applied and incorporated with a rototiller. Corn planted 3 days later was injured but that planted 3 weeks later was unharmed.

Dalapon at rates of 10 to 20 lb/A continued to kill a high percentage of old plants; however, the use of tillage allowed for the use of a reduced rate in one instance. Rates of 4 to 11 lb/A applied to plants 12 to 24 in. tall followed with plowing one week later and disking another 3 days later killed 86 to 88% of the plants. Winter wheat seeded 5 weeks after application of 15 lb/A and corn planted 11 to 25 days after application of 4 to 11 lb/A were not injured.

Rates of 2 to 8 lb/A of Fenac (2,3,6-trichlorophenylacetic acid) were unsatisfactory when followed with plowing and disking. Residual effect injured corn planted 25 days after treatment.

TCA, HCA, and sodium chlorate continued to be effective chemicals for eliminating dense stands and for spot treatments of stray plants. HCA mixed in kerosene at rates of 90 to 180 ml/gal, TCA mixed with water at a rate of 1 lb/gal and 1 gram of chlorate per plant were successful for spot treatments.

Quackgrass or **couchgrass** *(Agropyron repens* L.). Results in 1959 confirm earlier results with dalapon, amitrol, TCA and monuron. They emphasize the need for tillage when using dalapon, amitrol or TCA. Several combinations of mowing, spraying and tillage were tested for use with amitrol and 2,3,6-TBA. Some of the better combinations were: (1) mow and spray 1st year and 3 sprayings 2nd year using 5 lb/A of amitrol or 5 lb/A of 2,3,6-TBA; (2) mow, spray and cultivate 1st year and 3 sprayings 2nd year using 3.2 lb/A of amitrol; and (3) mow, spray and cultivate 1st year and 3 cultivations second year using 0.6 lb/A of amitrol.

Diuron and fenuron appeared to be about equal to monuron; however, fenuron allowed reinfestation one year (6 yrs) sooner than monuron. The rate of diuron was reduced from 40 lb/A to 25 lb/A by adding 8 lb/A 2,3,6-TBA.

EPTC at rates up to 15 lb/A was unsatisfactory even when accompanied by double one-way disking before treatment and again 2 months later. Fenac at 15 lb/A followed with a rototilling appeared to have promise for eliminating quackgrass, while cacodylic acid used in the same manner at rates up to 30 lb/A did not.

In a limited number of tests, Atrazine (2-chloro-4-ethylamino-6-diethylamino-*s*-triazine) appeared very promising when applied at a 4 lb/A rate to quack sod during early spring. The sod was plowed and planted to corn, which was not cultivated. Nitrogen fertilizer was applied early, late and as a split application. The date of fertilizer application did not appear to influence results materially. Although simazin handled in the same manner was equally effective when applied in the fall, it acted too slowly to be satisfactory when applied in the spring and the residual effect was harmful to the succeeding small grain crop.

Broadleaved Perennials

Canada thistle *(Cirsium arvense* L.) and **perennial sowthistle** *(Sonchus arvensis* L. or *S. uliginosus* Bieb). In several experiments an application of 1 lb/A of 2,4-D, 2 lb/A of 4-(2,4-DB) or 3 lb/A of amitrol applied during a fallow year to Canada thistle after one spring cultivation when the weeds were in the bud stage of growth with cultivations resumed 6 weeks after treatment, eliminated a high percentage of the weeds. A spring cultivation followed with an application of ½ to ¾ lb/A of 2,4-D at budding and again 2 weeks later, followed with a cultivation at freezeup, was equally effective. BDM (90.5% disodium tetraborate hydrates and 7.5% 2,4-D), borax or 2,3,6-TBA were effective but residual effect damaged the succeeding crop. Twenty lb/A of 2,3,6-TBA eliminated 95 to 100% of the weeds without cultivation; but a 10 lb/A rate was unsatisfactory even when subsequent cultivations were performed. A mixture of 1 lb/A of 2,3,6-TBA and ½ lb/A of 2,4-D appeared promising. However, a 12 lb/A rate of amitrol was required to kill 99% of Canada thistle growing in

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competition with bromegrass, which was injured by the chemical.

Leafy spurge (*Euphorbia esula* L.) Amitrol appeared to be effective when used in several combinations of mowing, spraying and cultivating. The most successful combinations were: (1) mow and spray during late July 1st year and spray once second year using 5 lb/A; (2) mow, spray twice and disk twice first year and spray twice 2nd year using 5 lb/A of amitrol; and (3) spray, disk, spray, 1st year, and spray twice 2nd year, using 4 lb/A. Amitrol T (amitrol plus ammonium thiocynate) at rates of 8 to 16 lb/A killed 95% of the leafy spurge.

In one test several metallic salts of 2,3,6-TBA and the sodium salt of Fenac appeared to be more effective than the dimethyl amine salt of 2,3,6-TBA when no cultivation was used. Rates of 3 lb/A cesium salt of 2,3,6-TBA, 4 lb/A lithium salt of 2,3,6-TBA, 4 lb/A Fenac and 6 lb/A, potassium salt of 2,3,6-TBA applied during 1959 appeared to have killed 95% of the spurge, while 8 lb/A of amine salt of 2,3,6-TBA killed less than 50%.

Several soil sterilants gave promise of being useful for the elimination of spurge in aspen (*Populus tremuloides*) trees: BDM 2¾ to 5½ lb/sq rd, borax 5½ to 11 lb/sq rd, MDM (13% monuron and 8% 2,4-D) 2¾ lb/sq rd, B(MCPA) MM (93% sodium metaborate, 5% MCPA, 2% monuron) 5½ lb/sq rd and B(MCPA) M (95% sodium metaborate, 5% MCPA) 5½ lb/sq rd.

Russian knapweed (*Centaurea repens* L.). In several tests 15 to 20 lb/A 2,3,6-TBA or 40 lb/A PBA applied during the fall, eliminated over 95% of the knapweed. Such treatments generally injured perennial grass competitive crops.

Field bindweed (*Convolvulus arvensis* L.). In limited trials 5 and 10 lb/A rates of PBA followed with plowing and 2 cultivations eliminated 85 and 96% of the bindweed. Results were unsatisfactory when 2 cultivations were omitted. In one instance, ⅓ lb/A of 2,4-D ester applied at monthly intervals eliminated 97% of the weeds in one year.

Hoary cress (*Cardaria draba* (L.)Desv.) In one test 2- and 4-lb//A rates of amitrol or amitrol T applied at full bloom followed with fall plowing and a crop of winter wheat eliminated 98% of the weeds. A June application of 6 lb/A of either chemical followed with a July cultivation was equally effective. Ten lb/A of 2,3,6-TBA and 2¾ lb/sq rd of 46.5% sodium borate also gave close to 100% elimination.

Bur ragweed (*Franseria tomentosa* A. Gray). Rates of 12 and 20 lb/A of 2,3,6-TBA killed 92 and 100% of the weeds, while rates of 8 and 12 lb/A of Fenac killed 91 and 100% when applied during early July in one test. All treatments injured sorghum planted 10 to 11 months later.

Toadflax (*Linaria vulgaris* Mill.) Most of the 1959 work confirms results obtained earlier regarding fall application of soil sterilants and the need for a weed control program during the fallow year of an alternate fallow and cropping system. In one test amitrol was useful in the fallow year when applied at the rate of 8 lb/A during late July and cultivated (one-way disk) either 10, 17, 24 or 31 days after treatment. In another test, 10 lb/A of amitrol applied during August or September gave 100% elimination without subsequent cultivations. Other chemicals appeared to be effective when applied one year and as retreatments once or twice the 2nd year. Promising treatments included a total of 8.5 lb/A of erbon or 4 lb/A of 2,4-D and 2,4,5-T mixed or 3 lb/A of 2,4,5-T in 3 treatments or 2 lb/A of 2,3,6-TBA or 6 lb/A of 2,4-D ester in 2 treatments or 2.2 lb/A of mixed chlorinated benzoic and cresoxyacetic acids in 3 treatments.

Absinthe (*Artemesia absinthium* L.). Treatment when weeds were 8 in. tall, resulted in 100% elimination when 14 lb/A of amitrol or 13 lb/A of 2,3,6-TBA were used. Retreatment the second year gave equally good results when 6 lb/A of 2,4,5-T ester, 4 lb/A of 2,3,6-TBA or 4 lb/A of amitrol were used. In another test, 8 lb/A of amitrol or 2¾ to 9¼ lb/sq rd of BDM or 11 lb/sq rd of BMM (90.5% of disodium tetraborate hydrates and 4% monuron) were used.

Tanweed (*Polygonum coccineum* Muhl.). Sixteen lb/A of the sodium salt of 2,3,6-TBA resulted in 97% elimination in one test. Other results confirm earlier results when chlorate, borax and chlorate-borax mixtures were used.

Common milkweed (*Asclepias syriaca* L.). An application of 2 lb/A of amitrol T when the milkweed was in full bloom killed 99% of the weeds in one test.

Climbing milkweed (*Ampelamus albidus*). Application of 20 lb/A 2,3,6-TBA, 60 lb/A PBA, 160 lb/A erbon, 12 lb/A simazin without subsequent cultivation or 8 lb/A of amitrol followed with plowing eliminated 95% of the weeds. Treatments with 80 lb/A of erbon or 40 lb/A of PBA were less effective.

Scentless mayweed (*Matricaria inodora* L.). In one test, treatment when the weeds were 3 to 4 inches tall resulted in 95 to 98% kill when 8 lb/A of monuron or 2 lb/sq rd of sodium chlorate were applied. A 10 lb/A treatment with amitrol was unsatisfactory. Treatment with 12 lb/A of a chlorinated benzoic and cresoxyacetic acid mixture gave 99% kill and prevented reinfestation from seedlings the next year, while 8 lb/A of 2,4-D killed 90% of the plants and allowed reinfestation from seedlings.

Grassy Annual Weeds

Wild oats (*Avena fatua* L.). Pre-emergence application of herbicides was reported for more than 20 experiments.

EPTC granular or emulsifiable incorporated with a disk or rototiller at a rate of 2 lb/A generally reduced stands 70 to 80% while rates of 3 to 4 lb/A reduced stands 95%. However, there were instances where 1 to 2 lb/A reduced stands over 90% and cases where a 4 lb/A rate was less than 80% effective. Rates of 2 to 4 lb/A generally injured wheat, while rates of 4 to 6 lb/A seldom reduced yields of weed-infested flax or barley even though the stand of barley was sometimes reduced. In one test, 4 lb/A depressed the yield of weedfree barley.

Avadex (2,3-dichloroallyl diisopropylthiolcarbamate) granular and emulsifiable at rates of 2 to 3 lb/A generally reduced stands of wild oats 90 to 100%. In a few cases where lower rates were tested, 1 lb/A was equally effective. Less satisfactory results were obtained with 3 lb/A in one test and 4 lb/A in another conducted under conditions of abnormally cold weather. As a general rule the yield of weed-infested barley, wheat or flax was not decreased by rates of 1 to 3 lb/A though the stand was sometimes reduced.

In one test 1 lb/A of simazin or 1 lb/A of Atrazine or 2 lb/A of Trietazine (2-chloro-4-ethylamino-6-diethylamino-*s*-triazine) gave excellent control of wild oats, while causing injury to 10 other crops including small grains.

Treatment with 2,6-dichlorobenzonitrile (N5996) at rates of 1 to 2 lb/A gave unsatisfactory control of wild oats in 4 tests and decreased wheat yields in 2 of them. Similar results were obtained with rates up to 16 lb/A of Zytron (*O*-(2,4-dichlorophenyl) *O*-methyl isopropylphosphoramidothioate).

Carbyne (4-chloro-2-butynl *N*-(3-chlorophenyl)carbamate, S-847) was reported for 15 experiments. Rates of ½ to 1 lb/A were generally satisfactory when applied to wild oats in the 1½-to 3-leaf stage of growth while growing in wheat. The lower rate was more effective when applied at the earlier stage of growth. Although the higher rate was usually effective on the later stage of growth, it depressed crop yield on occasion. In most tests the chemical was applied in 2 volumes of carrier; 5 to 8 gpa and 30 to 35 gpa. The lower volume gave better results in about half the tests; the reverse was true for some and there was no difference for others.

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Such treatments resulted in a high degree of control even though the stand was sometimes not reduced materially. In such cases the wild oats plants turned blue and the leaves became thicker during the first 8 to 10 days after treatment. During the succeeding 2 or 3 weeks, many leaves became necrotic and withered. Later new stem and leaf initials became noticeable. At normal heading time the wild oats plants were weak, spindly and retarded. Although the weeds recovered and headed late, their dry weight had been greatly reduced. Competition had apparently been reduced during the critical grand period of growth for the crop and crop yield was not depressed.

Flax was more susceptible to Carbyne than wheat, especially at later stages of growth. In one test involving 3 flax varieties, Redwing appeared to be most tolerant, Redwood most susceptible and Rocket intermediate. All were much more tolerant to treatment at the 3-true leaf stage than at the 8-true leaf stage of growth.

The use of delayed seeding and crop rotation continue to be useful methods of control. One 1959 test indicated that late September and early October cultivations were more helpful than later fall cultivations for reducing the stand for the following year.

Foxtails (*Setaria* spp.). Results obtained during 1959 confirm earlier results which showed that 1 lb/A of dalapon or 5 lb/A of TCA eliminated a high percentage of foxtails if applied before the weeds were over 3 in. tall. In one test, rates of 1½ to 3 lb/A applied to 1 in. foxtail in 4-leaf barley reduced foxtail stands 55 to 75% respectively without injuring the crop.

Several chemicals were tested in pre-emergence applications. Stand reductions of 85 to 95% were obtained with 3 to 4 lb/A simazin granular, 4 to 5 lb/A CDAA granular, 1 to 3 lb/A Fenac granular, 4 to 6 lb/A EPTC granular and 4 to 6 lb/A Avadex granular. Atrazine granular at rates of 3 to 5 lb/A reduced stands an equal amount for about 6 weeks, but late germinating weeds increased the stand to almost 100% by mid-August. Butyl ester of 2,4-D and butoxyethanol ester of 2,4-D applied one week after seeding wheat, at a 2 lb/A rate suppressed weed growth. A 4 lb/A rate reduced the stand 100% but also depressed crop yield over 50%. Applications of 1 lb/A 2,6-dichlorobenzonitrile, 16 lb/A of Zytron, 1 lb/A of simazin spray, 1 lb/A of Atrazine spray and 2 lb/A of Trietazine spray were much less satisfactory.

Post-emergence application of 1 lb/A of 2,4-D butyl ester when foxtail was in 1-leaf stage and wheat in 3-leaf stage prevented weed seed production. Similar treatments with 1 lb/A of Fenac, Carbyne, or 2,3,6-TBA were ineffective. A similar rate of Amoben (3-amino-2, 5-dichlorobenzoic acid) when weeds were 2 to 6 in. tall was also effective.

The growth of darnel (*Lolium temulentum* L.) in flax was suppressed when treated at the 3- to 5-leaf stage with Amoben ¼, ½, and 1 lb/A, TCA 1, 2, and 4 lb/A and dalapon 1 lb/A. EPTC 1 lb/A and dalapon ¼ and ½ lb/A were less effective.

Crabgrass (*Digitaria* spp.) was completely eliminated with simazin 1 lb/A, Atrazine 2 lb/A and diuron 2 lb/A. Stand reduction of 85 to 95% was obtained with Atrazine 1 lb/A, diuron 1 lb/A, monuron 2 lb/A and neburon 4 lb/A. Lower rates of these herbicides and EPTC 4 lb/A, DNBP 9 lb/A and CDAA 6 lb/A did not give satisfactory results.

Broadleaved Annuals

Wild buckwheat (*Polygonum convolvulus* L.). Over a period of 4 years an application of 5 oz/A of butyl ester or butoxyethanol ester of 2,4-D, applied when buckwheat was in the cotyledonous stage of growth, generally reduced the stand 85 to 90%. Esters of MCPA, 4(2,4-DB) and 4 (MCPB) were less effective at rates up to 1 lb/A. Likewise, the applications of 5 oz/A of a 2,4-D ester when the buckwheat was in the 2-leaf stage of growth followed 7 to 10 days later with a repeat application was effective in reducing buckwheat stands.

In one experiment, isooctyl ester of 2,4-D applied at 5- and 8-oz/A rates failed to kill buckwheat when applied at the 1- to 2-leaf stage, but gave complete elimination when applied at the 6- to 8-leaf stage. Several other esters of 2,4-D and several esters (including isooctyl) of MCPA or 2,4,5-T were less effective. In another test butyl ester and butoxyethanol esters of 2,4-D were mixed at 5- and 8-oz/A rates with 2 oz/A of 2,3,6-TBA or 1,1'-diethylene-2,2'-bipyridinium dibromide and applied to buckwheat at the 1- to 2-leaf stage. These mixtures gave good control, but mixtures of these 2,4-D esters with 2 oz/A of amitrol or Fenac were less satisfactory. An application of 1 lb/A of Carbyne was unsatisfactory in the same test.

Ladysthumb (*Polygonum persicaria* L.) in barley was eliminated with 1 lb/A 2,3,6-TBA, a mixture of 1 lb/A 2,3,6-TBA and ½ lb/A 2,4-D ester or 2 lb/A of neburon, but the crop was injured with 2,3,6-TBA treatments.

Hemp nettle (*Galeopsis tetrahit* L.). In one test 2 to 4 lb/A neburon and a mixture of 1 lb/A 2,3,6-TBA and ½ lb/A 2,4-D ester gave 100% elimination in barley; however, the mixture reduced crop yield.

Others. A series of experiments, in which several chemicals were applied when the species with an erect type of growth were 4 to 8 in. high with some taller species measuring 12 in., were reported. The following rates of the various chemicals gave satisfactory control of the specified weed species growing with crops which offered little competition:

2,4-D amine ½ lb/A—yellow mustard (*Brassica arvensis* (L.) Rabenk.); 2,4-D amine or ester 1.4 to 2 lb/A—lambsquarters (*Chenopodium album* L.), pennycress (*Thlaspi arvense* L.), shepherd's purse (*Capsella bursa-pastoris* (L). Medic.) and tansy mustard (*Descurainia sophia* (L.) Webb); 2,4-D amine or ester 2 to 3 lb/A—Russian thistle (*Salsola kali* L.), Russian pigweed (*Axyris amaranthoides* L.), *Monolepis nuttalliana* (Schultes) Greene), prostrate pigweed (*Amaranthus graecizans* L.), sticktight (*Lappula echinata* Gilib.), kochia (*Kochia scoparia* L.), cut-leaf nightshade (*Solanum triflorum* Nutt.), purslane (*Portulaca oleracea* L.) and sweetclover (*Melilotus* spp.).

MCPA amine and ester ½ to 1 lb/A—lambsquarters, pennycress and yellow mustard; MCPA 1 to 2 lb/A—shepherd's purse and *Monolepis nuttalliana;* MCPA 2 to 3 lb/A—purslane, tansy mustard, cut-leaf nightshade, sticktight and sweetclover; MCPA over 3 lb/A—Russian thistle and Russian pigweed.

2,4-DB sodium salt 1 to 2 lb/A—lambsquarters, pennycress, and *Monolepis nuttalliana;* 2,4-DB sodium salt 4 to 6 lb/A—Russian thistle, Russian pigweed, tansy mustard, cut-leaf nightshade, sticktight and sweetclover. 2,4-DB sodium salt over 6 lb/A—purslane and shepherd's purse.

MCPB sodium salt 2 to 3 lb/A—lambsquarters, pennycress and *Monolepis nuttalliana;* MCPB sodium salt 7 to 8 lb/A—Russian thistle, Russian pigweed, purslane, shepherd's purse, tansy mustard and cut-leaf nightshade; MCPB sodium salt over 2 lb/A—sticktight and sweetclover.

Simazin or Atrazine 1½ to 2½ lb/A—purslane, lambsquarters, Russian thistle, Russian pigweed, prostrate pigweed and sweetclover.

In other tests, pre-emergence application of EPTC granular 2 lb/A, EPTC emulsifiable 3 lb/A, simazin 1 lb/A and Atrazine 1 lb/A gave excellent control of mustard, lambsquarters and rough pigweed (*Amaranthus retroflexus* L.). Trietazine 2 lb/A and 2,6-dichlorobenzonitrile (N5996) 2 lb/A were less satisfactory. Pre-emergence treatment with Fenac 15 lb/A prevented growth of pennycress, lambsquarters and night-flowering catchfly (*Silene noctiflora*).

XUM

WEED CONTROL IN CORN, SORGHUM AND SOYBEANS

F. W. Slife

Soybeans. Several new pre-emergence chemicals were evaluated in 1959. Of these, Amoben (3-amino-2, 5-dichlorobenzoic acid) controlled weeds best under the 1959 environmental conditions. Rates of 3 to 4 lb/A produced good to excellent weed control. Several reports indicated beans were stunted with rates of 4 lb/A and above of Amoben but where yields were taken, this apparently was not reflected in yields.

Combinations of NPA and CIPC were reported to give better weed control than either herbicide alone but under heavy rains this combination caused some bean stunting.

Two new triazine compounds produced injury on soybeans.

Granular forms were compared to liquid by only a few investigators. Where comparisons were made, the results in terms of weed control and crop injury were about the same.

Corn. Most of the pre-emergence herbicides available for corn were evaluated in 1959. Results in terms of weed control were good when rain fell soon after application. Under dry conditions, none were satisfactory. Simazin (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine) gave excellent weed control in most cases but Atrazine performed slightly better when rainfall was limited. Both failed to control weeds when light showers fell. Randox T (CDAA plus trichlorobenzyl chloride) was usually superior to CDAA for weed control, apparently because of better broadleaf weed control. Injury to corn was reported from at least one investigator from 2,4-D, Falone, and Eptam. Injury resulted when heavy rains followed soon after application.

Atrazine as an early post-emergence treatment gave good control of annual weeds without corn injury in several tests. Amitrol used in the same way gave more variable results.

Granular pre-emergence herbicides were compared with liquids in several tests. In one test, both forms gave comparable results while in another, the liquid forms were slightly superior.

Sorghum. A limited amount of work was reported in 1959 on weed control in sorghums. Three investigators used a variety of pre-emergence materials at various rates. The results varied widely and no one material seems to be outstanding for the entire North Central Region.

At the present time, good cultural practices plus 2,4-D post-emergence seem to be the best weed control methods for sorghum.

WEED CONTROL IN SMALL GRAINS

L. E. Anderson

Weed research in small grains in 1959 was directed primarily to the control of wild oats in spring sown wheat, barley, and flax. Other problems receiving attention were foxtail, Canada thistle, wild buckwheat and the effects of herbicidal residues on various crops. Only one experiment involving winter grain was reported.

Included among the herbicides most commonly used to control wild oats were Carbyne (4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate), Avadex (2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture), and Eptam (EPTC). Although Carbyne was generally given most attention and apparently is effective in controlling wild oats, Avadex and Eptam were also used successfully under certain conditions. Evidence indicates that Carbyne was most effective when applied to wild oats seedlings at four to nine days following emergence; this period generally included the 1½ to 3 leaf stage of growth. Most reports indicate that 1 lb/A was more effective in controlling wild oats than the lower rates used. Reports on effectiveness of carrier volumes vary due possibly to difference in growing conditions at the various locations. Yields of wheat, oats and barley generally were increased when the wild oats population was reduced by Carbyne. Varietal differences in tolerance of wheat, barley and flax were reported for rates up to 1 lb/A; no differences were observed at 2 lb/A. In some instances Carbyne delayed maturity in barley and wheat. Under-seedings of alfalfa-brome mixtures sprayed with Carbyne were not injured.

Avadex was reported to control wild oats at rates of 1½ to 3 lb/A when incorporated in the soil as a pre-sowing treatment. No injury to barley or flax was reported; wheat tolerance varied from some injury to increases in yield.

Although Eptam controlled wild oats under certain conditions it was not as consistent as Carbyne or Avadex. Barley appeared more sensitive to Eptam residues than flax or alfalfa.

Late September or early October tillage was more effective in controlling wild oats than late fall or early spring cultivations.

Reports on control of Canada thistle, wild buckwheat, green foxtail, and darnel in wheat, barley or flax did not include promising new developments.

Oats following corn where triazine compounds had been used to control weeds were injured by residues of 4 lb/A applications of all the analogues in 1959 and by Propazine (2-chloro-4,6-bis(isopropylamino)-*s*-triazine) in 1958. Applications of 1 or 2 lb/A of the triazine analouges did not result in injury to oats or reduction in yield over the 2-year period.

CONTROL OF WEEDS IN OTHER FIELD CROPS

M. K. McCarty

Forage legumes. Most of the abstracts reported results with EPTC. Liquid and granular formulation comparisons revealed little or no difference in effectiveness. Incorporating either material into the soil prior to planting gave better results than pre-or post-emergence use. Phenoxyacetic and phenoxybutyric materials alone and in combination with dalapon continued to give good results as post-emergence treatments. Preplanting incorporation and pre-emergence applications of 2, 5-dichloro-3-aminobenzoic acid at 2, 4, and 6 lb/A, respectively, gave excellent control of pigweed, smartweed, barnyardgrass and foxtail species. At the 2 lb/A rate, pre-emergence treatment seemed to be slightly more effective. The legumes are listed from most to least susceptible as follows: red clover, alfalfa, birdsfoot trefoil, alsike clover and sweetclover. Only sweetclover appeared to be tolerant with birdsfoot trefoil and alsike clover making some recovery.

Sugar beets. EPTC at 2-6 lb/A incorporated in the soil pre-planting gave good weed control in tests reported but gave some stand reduction at the higher rates. 2,3-dichloroallyl diisopropylthiolcarbamate was reported in 2 abstracts as giving good grass control, particularly wild oats. Beet stand reduction was less than 25 percent and this did not affect yield.

Pastures. New seedings of bromegrass and crested wheatgrass treated at 2-4 in height with 2 lb/A mixed amines of 2,4-D, butyl ester of MCPA and Na salts of 4(2,4-DB) and 4-(MCPB) showed no significant damage from any of the herbicides. Weed control was better with the phenoxyacetic materials. Spring treatments with 2,4-D up to 2 lb/A and 2,3,6-TBA at 2, 4 and 8 lb/A

XUM

were made on Kentucky bluegrass being used for seed production. 2,3,6-TBA at the higher rates and 2,4-D ester at 2 lb/A reduced the yield significantly. Fall treatments with simazin, neburon, CIPC, CDAA, NPA and 2,3,6-TBA revealed severe to complete loss of sod with 1 and 2 lb/A of simazin. NPA at 8 lb/A and neburon at 4 lb/A significantly increased the yield of seed over check.

Other crops. EPTC at 3 lb/A and Trietazine (2-chloro-4-ethylamino-6-diethylamino-*s*-triazine) at 2 lb/A gave good weed control in tobacco several weeks after transplanting and comparatively little injury immediately following transplanting. DMTT at 6-9 lb/A gave good control of weeds in tobacco plant beds with no reduction in emergence or early growth of the tobacco. Calcium cynanamide alone or in various combinations with DMTT gave good weed control but poor production of tobacco plants.

CDAA at 4-6 lb/A gave good *Setaria* spp. control, partial broad-leaved weed control and no injury to sunflowers. The planted sunflowers were susceptible to 2lb/A simazin but resistant to EPTC at 3 lb/A incorporated.

Fourteen crop species with potential industrial uses were screened with CDAA at 4 lb/A and EPTC at 3 lb/A applied immediately after planting. Only sunflower *(Helianthus annuus)* was resistant to both treatments with all the other showing varying degrees of susceptibility to EPTC. *Eruca sativa, Raphanus sativus* and *Euphorbia marginata* were resistant to CDAA while the remaining 10 species ranged from moderately resistant to very susceptible.

WEED CONTROL IN HORTICULTURAL CROPS

E. K. Alban

Fruit. Amitrol at 8, 10, 12 lb/A provided excellent control of hoary cress, growing under crabapple trees, when applied in early June with weeds in flower. No damage was noted on the crabapple.

Flowers. A two-year study using various herbicides as post-planting treatments with chrysanthemums reported good to excellent weed control with apparently no crop damage following the use of monuron, sesone plus diuron, tris-(2,4-dichlorophenoxyethyl) phosphite (3Y9), and 2-chloro-4-diethylamino-6-isopropylamino-*s*-triazine (G-30031).

Vegetables. Some of the newer chemicals reported in the sixteen abstracts received were: triethylamine salt of 3-amino-2,5-dichlorobenzoic acid, (carrot, cucumber and peas); dimethyl 2,3,5,6-tetrachloroterephthalate, (peas); 2-chloro-4-ethylamino-6-diethylamino-*s*-triazine, (Lima and snap beans, onions and peas); O-2,4-dichlorophenyl-*O*-methyl isopropylphosphoramidothioate (peas, Lima and snap beans); and (4-dichlorophenyl)-1-isopropyl-1-(2-propynyl)urea, post-emergence only (carrot, cucumber and onion).

Turf. Seven abstracts were received, five were concerned with crabgrass control and turf-grass injury, one with nimblewill control, and one with tolerance of Kentucky bluegrass and creeping red fescue to 2,3,6-trichlorophenylacetic acid (sodium salt and acetamide derivatives).

Two of the newer chemicals which received generally favorable reports as related to crabgrass control and minimum turf injury were dimethyl-2,3,5,6-tetrachloroterephthalate and 2,4-dichlorophenyl *O*-methyl *O*-isopropylphosphoramidothioate.

WEED CONTROL IN FORESTRY AND ORNAMENTAL NURSERIES AND SHELTERBELTS

L. G. Holm and J. E. Kuntz

No new findings were reported in 1959. Results reported this year support information contained in the Research Summaries, NCWCC, 1958.

WOODY PLANT CONTROL

R. H. Beatty

Abstracts received indicate that work is being done primarily on individual problem species.

2,4,5-T appeared to be the most practical eradicant of caragana in Alberta, with intact plant response greatly superior to that of 1′ stubs.

2,4,5-T propylene glycol butyl ether (PGBE) ester at 2½ lb/A or more in water was the most effective of 5 chemicals on multiflora rose in Missouri. Three annual treatments killed 92%. 10.4 g/plant of monuron applied to the soil at the base of each plant gave 90% kill; 20.8 g/plant of 2,3,6-TBA gave 87% kill.

In Michigan, 14 months after application there were no apparent differences between red maple trees girdled in the winter and treated with various undiluted formulations in July. When trees were girdled in July and treated the same day there were significant differences.

Amitrol (2 lb/gal), amitrol plus PBA amine salt (1 lb plus 4 lb/gal), 2,4,5-T PGBE ester (4 lb/gal) and 2,4,5-T butoxyethanol ester (4 lb/gal) produced 88, 86, 84 and 84% control respectively. 2,4-D + 2,4,5-T mixtures appear to be at least equal to any of the various herbicides applied as foliage sprays to mixed vegetation of sand dunes near Devon, Alberta.

In Saskatoon, soil sterilants for parking areas gave better weed control on the north side of a large building than on the south side. CBM at 8 lb/sq ft, BMM at 1, 2 and 4 lb/sq ft, fenuron at 25, 50 and 100 lb/A and monuron at 50 lb/A gave 95% or better control there.

AQUATIC WEED CONTROL

J. E. Gallagher

Recent reports indicate that the sodium salt of endothal is of low toxicity to fish and very effective in the control of algae *(Pithophora* and *Cladophora* spp.) at 5-10 ppm, pondweeds *(Potamogeton* spp.) at 5-10 ppm and coontail *(Ceratophyllum demersum)* at rates above 1 ppm.

Simazin continued to give favorable results in the control of algae, pondweeds and coontail.

Prometone (2-methoxy-4-6-bis(isopropylamino)-*s*-triazine) 4 lb/A gave promising results in control of cattails *(Typha* spp.).

Mixed formulations of two or more herbicides offer potential in controlling complex weed problems and pelleted and granular formulations offer many advantages in the field of fisheries management.

NEW HERBICIDES

A. J. Watson

The following summary is based on results reported in 78 abstracts and covers 22 compounds. Only the more recently introduced compounds have been included. For clarification and simplicity the common name, trademark or code number is indicated in parenthesis following the chemical nomenclature.

XUM

4-Chloro-2-butynyl *N*-(3-chlorophenyl)carbamate (Carbyne) (19 reports). Used as a post-emergence selective spray at rates of ½ to 1 lb/A Carbyne has given good control of wild oats with only slight injury to spring wheat, barley or flax. Treatment at the 1-½ leaf stage has been most effective and relatively low spray volumes (5 gpa) have been more effective than higher volumes.

Carbyne has been much less effective where incorporated into the soil prior to planting.

Used as a post-emergence spray it has been relatively ineffective on green foxtail and *Bromus tectorum* as well as certain broad-leaved weeds including wild buckwheat. In one pre-emergence test used at 6 lb/A it gave fair weed control with severe injury to red beets.

2, 3-Dichloroallyl diisopropylthiolcarbamate (Avadex) (11 reports). Avadex has given effective control of wild oats where used at rates of 1 to 3 lb/A incorporated into the soil prior to planting. Residual phytotoxicity to crops has varied from none to severe.

Sodium 2,3,6-trichlorophenylacetate (Fenac) 24 reports). Used pre-emergence at 2 to 4 lb/A on corn, Fenac gave weed control ranging from poor to excellent. Grain sorghum was injured by both pre- and post-emergence applications. In combination with tillage it effectively controlled quackgrass at 15 to 30 lb/A. Applications made pre-plowing to established Johnsongrass at rates up to 8 lb/A gave poor control and residual injury to corn. Used as a soil sterilant at rates of 8 to 16 lb/A it gave good control of leafy spurge, bur ragweed, and tanweed. For pre- or post-emergence crabgrass control in bluegrass turf, it resulted in poor control and considerable turf injury.

Triethylamine salt of 3-amino-2,5-dichlorobenzoic acid (Amoben) (13 reports). Amoben has given good annual weed control in soybeans with little or no crop injury used pre-emergence at about 4 lb/A. Crop injury was reported where used pre-emergence on corn, sorghum, flax and red beets. Sweetclover, birdsfoot trefoil and alsike clover apparently are relatively tolerant, while red clover and alfalfa are susceptible to the compound. In several post-emergence tests the material was relatively inactive.

***O*-(2,4-dichlorophenyl) *O*-methyl isopropylphosphoramidothioate (Zytron)** (14 reports). Used pre-emergence for crabgrass control in bluegrass turf Zytron has been very effective at rates of 15 to 20 lb/A. Poor control was reported from Indiana in 1959. Spring treatments have usually given satisfactory crabgrass control for the season and bluegrass has shown a favorable growth reponse.

Poor results have been reported and the compound appears to offer little promise for mid-season post-emergence crabgrass control.

Late summer and early fall treatment at rates of about 40 lb/A have been effective in controlling crabgrass in turf for the following year.

Control of annuals has been variable and often poor where used pre-emergence on field crops.

2-Chloro-4-ethylamino-6-isopropylamino-*s*-triazine (Atrazine) (12 reports). Atrazine gave good control of annual broadleaved weeds and grasses without crop injury where used pre-emergence on corn at about 2 lb/A. Many other crops are injured by the compound. A post-emergence treatment was very injurious to carrots but was tolerated by corn. It shows promise as a pre-plowing foliar treatment for quackgrass at 4 to 8 lb/A in areas to be planted to corn.

2-Chloro-4,6-bis(isopropylamino)-*s*-triazine (Propazine) (3 reports). Propazine was used pre-emergence on corn as well as pre- and post-emergence on grain sorghum. Results indicate that grain sorghum will tolerate rates up to 2 lb/A either pre- or post-emergence. Degree of weed control was variable.

Tris(2,4-dichlorophenoxyethyl) phosphite (Falone) (8 reports). Falone was used pre-emergence on corn and grain sorghum at rates of 2 to 6 lb/A with variable results. Control of annual weeds was usually poor and injury to each crop was reported in at least one report.

Dimethyl-2,3,5,6-tetrachloroterephthalate (DAC-893) (6 reports). Used pre-emergence at 4 to 8 lb/A this compound gave poor weed control without injury to corn or grain sorghum and good weed control without injury to soybeans. In one test it resulted in good control of crabgrass in bluegrass turf, at rates of 7.5 and 10 lb/A.

1-Chloro-*N*-(3,4-dichlorophenyl)-*N*,*N*-dimethylformadine (duPont 685) (1 report). Good control of annual weeds without crop injury was reported where used post-emergence on field corn at .5 to 1.0 lb/A with kerosene as the carrier.

3-Phenyl-1,1-dimethylurea trichloroacetate (Urab) (1 report. Used pre-emergence at 3 lb/A on carrots, it resulted in poor weed control and no crop injury.

Propyl-ethyl-*N*-butylthiolcarbamate (1 report). Used pre-emergence at 4 lb/A on soybeans, it gave poor weed control and no crop injury.

N-Propyl-di-*N*-propylthiolcarbamate (1 report). Used pre-emergence at 4 lb/A on soybeans, it gave poor weed control and no crop injury.

Ethyl-ethyl-*N*-butylthiolcarbamate (1 report). Used pre-emergence at 4 lb/A on soybeans, it gave poor weed control and no crop injury.

(*p*-Chlorophenyl)phenylacetonitrile (L-09726) (4 reports). Used pre-emergence at 8 lb/A on soybeans, it gave poor weed control with no crop injury.

For pre-emergence crabgrass control in turf (3 reports) at rates of 4 to 12 lb/A, the compound gave poor control with no turf injury.

Diphenylacetonitrile (L-13489) (3 reports). For pre-emergence use in soybeans, 8 lb/A resulted in poor weed control with no crop injury.

Used pre- or post-emergence for crabgrass control in turf, the compound was ineffective and caused no turf injury.

2,6-Dichlorobenzonitrile (Nia. 5996) (3 reports). Incorporated into soil pre-planting, at 1 to 4 lb/A, it resulted in fair to good control of wild oats but residual phytotoxicity caused considerable injury to barley, wheat and flax.

***N*-butyl 2-propoxybenzoate (U-9613)** (1 report.) In one post-emergence application to crabgrass in bluegrass turf, there was poor control and no turf injury.

***N*-(3,4-dichlorophenyl-2-methylpentanamide) (Karsil)** (2 reports). The compound was used post-emergence at 2 lb/A on carrots and chrysanthemums and resulted in poor weed control with no crop injury.

***N*-(3,4-dichlorophenyl)methacrylamide (Dicryl)** (1 report). Used post-emergence on carrots at 4 lb/A, it gave good control of annuals without crop injury.

Mixed chlorinated benzoic and cresoxyacetic acids (CP-1815) (2 reports). The material shows promise in controlling toadflax by foliage treatment at 2 to 4 lb/A and scentless mayweed *(Matricularia inodora)* at 12 to 16 lb/A.

Cacodylic acid (1 report). At rates ranging from 5 to 30 lb/A poor control of quackgrass was obtained either with or without tillage.

APPLICATION EQUIPMENT AND METHODS, PREHARVEST CONTROL AND CHEMICAL DRYING

W. G. Lovely

No new findings were reported in 1959, consequently there is no change in information contained in Research Summaries, NCWCC, 1958.

CLASSIFICATION OF WEED PLANTS AS TO SUSCEPTIBILITY TO CERTAIN HERBICIDES

Prepared by: Research Committee, NCWCC

Legend Susceptibility Rating: + = slight, ++ = moderate, +++ = very susceptible, ++++ = eradication
− = no appreciable control, no entry = no information

Stage of Growth:
PE=Pre-emergence
GE—During early part of rapid growth period
GL—Near end of rapid growth period
FL=Bud or early flowering
FR=Near time of fruit maturity
LP=Functional leaves present

Notes:
(1) For seedlings—incorporated
(2) Incorporated
(3) Methoxy propazine
(4) Application followed by plowing
(R) Repeated application necessary

Susceptibility of Perennial Dicotyledonous Weeds to Certain Herbicides

Species	Amitrol	Phenoxy acids	Polychlor benzoics	Substituted ureas	Other
Absinthe *Artmemisia absinthium*	+++ 4 lb/A GE	+++ 2,4-D 4 lb/A GE	+++ 2,3,6-TBA 4 lb/A GE		
Bladder campion *Silene cucubalus*		++ 2,4-D 2 lb/A GE (R)			
Blueweed *Helianthus ciliaris*		+++ 2,4-D 2 lb/A GL (R)			
Bur ragweed *Franseria discolor*		+++ 2,4-D 2 lb/A FL			
Buttercup *Ranunculus acris*		++ 2,4-D 2 lb/A			
Canada thistle *Cirsium arvense*	+++ 4 lb/A FL	++ 2,4-D 1 lb/A GE-GL	+ 2,3,6-TBA 4 lb/A FL	++++ Monuron 40 lb/A GE-FR	
Chicory *Cichorium intybus*		++ 2,4-D 1 lb/A GL			
Climbing milkweed *Ampelamus albidus*	−	−	++ 2,3,6-TBA 20 lb/A GE	−	++ erbon 160 lb/A GE
Dandelion *Taraxacum officinale*	+	+++ 2,4-D 1 lb/A GE	+++ 2,3,6-TBA 4 lb/A		
Dogbane *Apocynum cannabinum*	−	++ 2,4,5-T 2 lb/A GL			
Field horsetail *Equisetum arvense*	+++ 4 lb/A	++ 2,4-D or MCP 1 lb/A GE-GL	−		
Hoary cresses *Cardaria* spp.	++ 4 lb/A	++ 2,4-D 2 lb/A GL or FL			
Horse nettle *Solanum carolinense*	+++ 4 lb/A FR	++2,4,5-T 2 lb/A GE	+ 4 lb/A FR		
Ironweed *Vernonia* spp.	+++ 4 lb/A	++ 2,4-D 2 lb/A GL			
Russian knapweed *Centaurea repens*		− 2,4-D − 2,4,5-T	+++ 2,3,6-TBA 20 lb/A GE		+++ 2,3,6-TBA 6 lb/A (4)
Leafy spurge *Euphorbia esula*	++ 4 lb/A	+ 2,4-D 2 lb/A	+++ 2,3,6-TBA 20 lb/A (Fall)	−	+++ 2,3,6-TBA 6 lb/A (4)
Milkweeds *Asclepias* spp.	++ 4 lb/A FL	+ 2,4-D 2 lb/A			
Perennial sowthistle *Sonchus arvensis*	++ 4 lb/A	++ 2,4-D 1 lb/A GL			
Plantains *Plantago* spp.	−	+++ 2,4-D 1 lb/A GE			
Povertyweed *Iva axillaris*		+++ 2,4-D 2 lb/A	++		
Rumex spp.	−	+ 2,4-D	+++		
Tanweed *Polygonum coccineum*	−	+ 2,4-D 1 lb/A	++ 2,3,6-TBA	++++	
Toadflax *Linaria vulgaris*	+	+ 2,4-D 20 lb/A FL		++++ 60 lb/A	
Vervains *Verbena* spp.		++ 2,4-D 1 lb/A GE			
Field bindweed *Convolvulus arvensis*		+++ 2,4-D ¾ lb/A GL(R)	+++ 2,3,6-TBA 20 lb/A (Fall)		
Goldenrod *Solidago nemoralis*		++ 2,4-D 1 lb/A GE-GL			
Hedge bindweed *Convolvulus sepium*		+++ 2,4-D ½ lb/A GE(R)			

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Susceptibility of Woody Plants to Certain Herbicides

Species	Amitrol	AMS (Ammate)	Phenoxy acids	Polychlor benzoics	Substituted ureas
Aspen *Populus* spp.	++	++++*	+++ 2,4-D 2 lb/100	++	++++ fenuron
Brambles *Rubus* spp.	++ 4 lb/100 GL	+++*	+++ 2,4,5-T 2 lb/100 GL	+++ 2,3,6-TBA 4 lb/100	++++ fenuron
Buckbrush *Symphoricarpos orbiculatus*	++ 4 lb/100 GL	++++*	+++ 2,4-D 2 lb/A GL	++	++++ fenuron
Cottonwood *Populus deltoides*	+ 4 lb/100	+++*	++ 2,4,5-T 2 lb/100		
Elders *Sambucus* spp.	+ 4 lb/100	+++*	++ 2,4-D 2 lb/100		—
Elms *Ulmus* spp.	+ 4 lb/100	+++*	++ 2,4,5-T 2 lb/100		+++ fenuron +++ monuron
Greenbrier *Smilax* spp.	—	+++*	—	—	
Hackberry *Celtis* spp.	+ 4 lb/100	+++*	+++ 2,4,5-T 2 lb/100		
Hickories *Carya* spp.	++ 9 lb/100	+++*	++++ 4 lb/100 2,4,5-T or TP	+ 2,3,6-TBA 4 lb/100	++ fenuron or monuron
Honeysuckle *Lonicera* spp.	+++ 10 lb/100	+++*	++ 2,4,5-T 2 lb/100		
Maples *Acer* spp.	—		+++ 2,4,5-T 2 lb/100		
Oaks *Quercus* spp.	+++ 9 lb/100	+++*	++ 2 lb/100 2,4,5-T or TP	++	++++ fenuron or monuron
Osage orange *Maclura pomifera*		+++*	+++ 2,4,5-T 2 lb/100		
Persimmon *Diospyros virginiana*	++ 9 lb/100	+++*	++ 2,4,5-T 2 lb/100	+++ 2,3,6-TBA 4 lb/100	+++ fenuron ++ monuron
Poison ivy and oak *Rhus* spp.	+++ 4 lb/100	+++*	++ 2,4-D 2 lb/100		
Prunus spp.	+ 4 lb/100	+++*	+++ 2,4,5-T 2 lb/100	++	
Juniper spp.	++ 4 lb/100	+++*	+ 2,4,5-T	+++	+++
Sumac *Rhus* spp.	++ 4 lb/100	+++*	+++ 2,4-D 4 lb/100	++++ 2,3,6-TBA 4 lb/100	
Sassafras *Sassafras varifolium*	—	+++*	+++ 2,4-D	++++ 2,3,6-TBA 4 lb/100	
Trumpet creeper *Tecoma radicans*	+	+++*	++ 2,4-D 4 lb/100		
Wild roses *Rosa* spp.	—		+++ 2,4,5-T	+++ 2,3,6-TBA 4 lb/100	+++ monuron
Willows *Salix* spp.	+	+++*	+++ 2,4-D 2 lb/100	++	++ fenuron

*¾-1 lb/gal LP (R) } For all entries under AMS with susceptibility rating

Susceptibility of Perennial Monocotyledonous Plants to Certain Herbicides

Species	Amitrol	Dalapon	EPTC	MH	Fumigants	Phenoxy acids	Polychlor benzoics	Substituted ureas	Triazines
Allium spp.	+ 4 lb/A GE	+ 6 lb/A GE	—	+ 6 lb/A GE	++++ CH_3Br or Vapam	++ 2,4-D 2 lb/A GE	+++ 2,3,6-TBA 4 lb/A GE		
Bentgrasses *Agrostis* spp.	+++ 4 lb/A	++			++++ CH_3Br	+		+++	
Bermudagrass *Cynodon dactylon*	++ 4 lb/A	++ 25 lb/A			++++ CH_3Br +++ Vapam	—			
Broomsedge *Andropogon virginicus*		++ 15 lb/A GE					+ 2,3,6-TBA 8 lb/A GE		
Cattails *Typha latifolia*	+++ 4 lb/A FL	+++ 30 lb/A GL				++ 2,4-D GL		+ + + monuron 40 lb/A GL	
Johnsongrass *Sorgum halepense*	—	+++ 30 lb/A GE	+++ 4 lb/A (1)	—		—		+ + + monuron 40 lb/A GL	
Nimblewill *Muhlenbergia schreberi*	+ 4 lb/A GL			+++ 7 lb/A GE				— diuron 20 lb/A	
Nutgrass *Cyperus esculentus*	+ 4 lb/A GL	—	++ 10 lb/A (2)	—		—		— neburon 2 lb/A	++ (3)
Star of Bethlehem *Ornithogalum umbellatum*						++ 2,4-D 2 lb/A GE	+++ 2,3,6-TBA 4 lb/A GE		
Quackgrass *Agropyron repens*	++ 4 lb/A GL (4)	++ 10 lb/A GE (4)	+	++ 4 lb/A GE (4)			++ 2,3,6-TBA GE	++++ Monuron 30 lb/A	+++ 4 lb/A GE (4)

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and

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Agscol Chemical, Inc.	Grand Forks, British Columbia
Alberta Pacific Grain Company (1943)	Calgary, Alberta
Allied Chemical Corporation	Edgewater, New Jersey
Allied Chemical Services, Ltd.	Calgary, Alberta
Amchem Products, Inc.	Ambler, Pennsylvania
American Cyanamid Company	New York, New York
Brown Farm Chemical Company	Scottsbluff, Nebraska
Burg Manufacturing Company	Waverly, Nebraska
Chemagro Corporation	New York, New York
Chipman Chemical Company, Inc.	Bound Brook, New Jersey
Chipman Chemicals Limited	Winnipeg, Manitoba
Clark Manufacturing Company	Atherton, Missouri
Columbia-Southern Chemical Corporation	Pittsburgh, Pennsylvania
Cyanamid of Canada, Ltd.	Toronto, Ontario
Dakota Improved Seed Company	Mitchell, South Dakota
Davey Tree Expert Company	Kent, Ohio
Delavan Manufacturing Company	West Des Moines, Iowa
Diamond Alkali Company	Cleveland, Ohio
Dow Chemical Company	Midland, Michigan
Dow Chemical of Canada, Ltd.	Winnipeg, Manitoba
E. I. DuPont de Nemours & Company	Wilmington, Delaware
Electric Reduction Company	Toronto, Ontario
Fargo Foundry Company	Fargo, North Dakota
Farmrite Sprayer, Inc.	Juneau, Wisconsin
F. H. Peavey and Company	Minneapolis, Minnesota
Federal Grain Company	Winnipeg, Manitoba
Fisons (Canada) Ltd.	Toronto, Ontario
Food Machinery & Chemical Corporation	Middleport, New York
Geigy Agricultural Chemicals	Yonkers, New York
Green Cross Products (Sherwin-Williams)	Montreal, Quebec
Hahn, Inc.	Evansville, Indiana
Hart Equipment Company	Rockton, Illinois
Heyden Newport Chemical Corporation	New York, New York
Hooker Electrochemical Company	Niagara Falls, New York
Hypro Engineering, Inc.	Minneapolis, Minnesota
Illinois Farm Supply Company	Chicago, Illinois
Inter-Provincial Co-ops, Ltd.	Winnipeg, Manitoba
John Brooks & Company, Ltd.	Montreal, Quebec
Keystone Chemicals, Ltd.	Aurora, Ontario
May and Baker (Canada), Ltd.	Montreal, Quebec
Miller Chemical Company	Omaha, Nebraska
Monsanto Chemical Company	St. Louis, Missouri
Mutual Dealers Wholesale, Inc.	St. Paul, Minnesota
National Aluminate Corporation	Chicago, Illinois
National Grain Company Limited	Winnipeg, Manitoba
Naugatuck Chemical	Bethany, Connecticut
Naugatuck Chemicals Ltd.	Winnipeg, Manitoba
Niagara Brands Chemical	Regina, Saskatchewan
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Oliver Chemical Company, Ltd.	Lethbridge, Alberta
Ortho Agricultural Chemicals	Vancouver, British Columbia
Pennsalt Chemical Corporation	Aurora, Illinois
Pioneer Grain Company, Ltd.	Winnipeg, Manitoba
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Reasor-Hill Corporation	Chicago, Illinois
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Woodbury Chemical Company	St. Joseph, Missouri

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Weeds, Crops, and General Index

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Barnyardgrass	*Echinochloa crus-galli*	43, 84, 85, 87, 92, 97, 98
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Beans, Lima	*Phaseolus lunatus*	98
Beans, snap	*Phaseolus vulgaris*	14, 45, 46, 47, 77, 98
Bearberry	*Arctostaphylos uvaursi*	104
Beets, red	*Beta vulgaris*	46, 77, 98, 100
Beets, sugar	*Beta vulgaris*	47, 50, 55, 94, 96, 110
Bentgrasses	*Agrostis* sp.	102, 103
Bindweed, field	*Convolvulus arvensis*	22, 35, 44, 74, 108
Bluegrass, Kentucky	*Poa pratensis*	67, 94, 101, 102, 103
Bluegrass, roughstalked	*Poa trivialis*	102
Blueweed	*Helianthus ciliaris*	35
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Bouncingbet	*Saponaria officinalis*	35
Bromegrass, downy	*Bromus tectorum*	92
Bromegrass, smooth	*Bromus inermis*	50, 55, 69, 81, 89,
Brush (general)		39, 104
Buckwheat, tartary	*Fagopyrum tataricum*	10
Buckwheat, wild	*Polygonum convolvulus*	10, 50, 55 80, 87, 91, 109
Bulbs, spring-flowering		14
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Bulrush, river	*Scirpus fluviatilis*	41
Bulrush, soft-stemmed	*Scirpus validus*	41
Bur-reed	*Sparganium eurycarpum*	41
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C		
Cabbage	*Brassica oleraceae, var. capitata*	46, 47, 98
Campion, bladder	*Silene cucubalus*	22
Caragana	*Caragana* sp.	104
Carpetweed	*Mollugo verticillata*	45, 85
Carrot	*Daucus carota sativa*	14, 46, 47, 77, 97, 98, 100
Cattails	*Typha* sp.	39, 41
Ceanothus	*Ceanothus* sp.	37
Cherry, pin	*Prunus pennsylvanica*	104
Chickweed, common	*Stellaria media*	103
Chickweed, mouse-ear	*Cerastium vulgatum*	103
Chokecherry	*Prunus melanocarpa*	104
Chrysanthemum	*Chrysanthemum murifolium*	101
Cladophora	*Cladophora* sp.	19
Clearing, woods, mechanical		5
Clover, alsike	*Trifolium hybridum*	92, 93
Clover, red	*Trifolium pratense*	92, 93, 94
Clover, white (Ladino)	*Trifolium repens*	92
Cocklebur	*Xanthium* sp.	16, 85
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Corn, sweet	*Zea mays*	46, 77
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Crabgrass	*Digitaria* sp.	43, 50, 55, 79, 80, 82, 83, 85, 94, 95, 101, 102, 103, 109
Cress, hoary	*Cardaria draba*	9, 22, 71, 108
Cucumber	*Cucumis sativus*	77, 98
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Darnel	*Lolium temulentum*	80
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Dogwood, flowering	*Cornus florida*	39
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E		
Elm	*Ulmus* sp.	43
Euonymus	*Euonymus* sp.	37
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Fescue, red or chewings	*Festuca rubra*	67, 101, 102, 103
Fir, balsam	*Abies balsamea*	35, 43
Fir, Douglas	*Pseudotsuga menziesii*	43
Flax	*Linum usitatissimum*	22, 47, 50, 51 75, 77, 78, 79, 80, 87, 88, 90, 91, 103
Flixweed	*Descurainia sophia*	81, 97
Flowers		101
Foxtail, giant	*Setaria faberi*	50, 53, 82, 85
Foxtail, green	*Setaria viridis*	11, 14, 75, 77, 78 79, 82, 84, 85, 94, 97, 100
Foxtail, yellow	*Setaria lutescens*	82
Foxtails	*Setaria* sp.	44, 45, 55, 79, 85, 86, 87, 92, 95, 97, 98, 100, 103, 109
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Common name	Scientific name	
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Girdling, trees		104
Gophers, striped	*Citellus* sp.	95, 96
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H		
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Hazelnut	*Corylus cornuta*	104
Hemp, water	*Acnida altissima*	82
Herbicides, granular		38, 40, 45, 46, 53, 54, 70, 79, 81, 82, 83, 85, 94, 98, 99, 100, 101, 103
Herbicides, new, summary		111, 112
Herbicides, pelleted. See herbicides, granular		
Highway weed control		37
Histological effects of herbicides		15
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Horsetail	*Equisetum arvense*	9
Honeysuckle, tartarian	*Lonicera tatarica*	43
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I		
Incorporation, of herbicides in soil		94
Industrial crops, potential		96
Industry, herbicide		12, 25, 27
Insect control of weeds		21
Invert emulsions		91
J		
Jimsonweed	*Datura stramonium*	85
Johnsongrass	*Sorgum halepense*	65, 66, 107
Junipers	*Juniperus* sp.	35, 37, 43
K		
Knapweed, diffuse	*Centaurea diffusa*	19
Knapweed, hybrid	*Centaurea jacea x C. nigra*	19
Knapweed, Russian	*Centaurea repens*	9, 18, 22, 35, 73, 108
Knapweed, spotted	*Centaurea maculosa*	19
Knapweeds	*Centaurea* sp.	18
Kochia	*Kochia scoparia*	81, 86
L		
Ladysthumb, see smartweed		
Lambsquarters	*Chenopodium album*	44, 45, 77, 78 81, 82, 83, 84, 85, 86, 91, 96, 97, 98, 99
Lawn weeds, see turf		
Laws, weed		29, 33
Leek	*Allium porrum*	55
Legumes		81, 110
Light, effect on herbicides		17
Lilies	*Lilium* sp.	14
Losses due to weeds		10
M		
Maple, red	*Acer rubrum*	104
Mayweed, scentless	*Matricaria inodora*	73, 108
Mechanical clearing of woods		5
Milkweed, climbing	*Ampelamus albidus*	108
Milkweed, common	*Asclepias syriaca*	73, 108
Millet, German	*Setaria italica*	82, 83, 86, 96, 98
Monolepis	*Monolepis nuttalliana*	81
Minutes, Board of Directors meetings		60
Morphology of weeds		16
Morningglory, annual	*Ipomoea purpurea*	50, 52, 55, 82, 85
Morningglory, ivy-leaved	*Ipomoea hederacea*	84
Mustard	*Brassica* sp.	77, 98
Mustard, tansy, see flixweed		
Mustard, wild	*Brassica kaber*	81, 96, 97, 98
N		
Narcissus	*Narcissus* sp.	14
Nettle, hemp	*Galeopsis tetrahit*	10, 80, 109
Nightshade, cutleaf	*Solanum triflorum*	81
Nightshade, silverleaf	*Solanum elaeagnifolium*	35
Nimblewill	*Muhlenbergia schreberi*	101, 103
Nursery stock, weed control in		42
Nutgrass, yellow	*Cyperus esculentus*	84
O		
Oats	*Avena sativa*	47, 48, 77, 78, 87, 91, 103
Oats, wild	*Avena fatua*	7, 14, 15, 24, 35, 36, 47, 49, 50, 51, 55, 74, 75, 76, 77, 78, 88, 89, 90, 91, 94, 96, 103, 108
Oleander	*Nerium* sp.	37
Onion	*Allium cepa*	14, 46, 47, 98, 99
Ornamental shrubs, weed control		14, 37
P		
Panicum, fall	*Panicum dichotomiflorum*	84
Parkland area		5
Parsnip	*Pastinaca sativa*	14
Pastures, weed control in		5, 110
Peas	*Pisum sativum*	47, 50, 55, 77, 97, 98
Peanuts	*Arachis hypogaea*	47
Peavine, veiny	*Lathyrus venosus*	104
Pennycress, field	*Thlaspi arvense*	81, 91, 96, 97
Persimmon	*Diospyros virginiana*	35
Phragmites	*Phragmites communis*	35, 41
Pigweeds	*Amaranthus* sp.	55, 97
Pigweed, prostrate	*Amaranthus graecizans*	80, 101
Pigweed, rough or redroot	*Amaranthus retroflexus*	44, 45, 52, 77, 78, 82, 83, 84, 85, 86, 92, 95, 97, 99, 100, 101, 103
Pigweed, Russian	*Axyris amaranthoides*	80, 81
Pines	*Pinus* sp.	35, 37, 43
Pine, red	*Pinus resinosa*	42, 43
Plowing		65
Pondweeds	*Potomogeton* sp.	41
Potato	*Solanum tuberosum*	14, 47, 77, 97, 100
Potato, sweet	*Ipomea batatas*	14
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Pumpkin	*Cucurbita* sp.	14
Purslane	*Portulaca oleracea*	45, 80, 81, 83, 97, 99, 100, 101
Pyracantha	*Pyracantha sp.*	37

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Weeds, Crops, and General Index (Continued)

Common name	Scientific name	
Q		
Quackgrass	*Agropyron repens*	9, 15, 34, 40, 44, 66, 68, 70, 97, 103
R		
Radish	*Raphanus sativus*	50, 55
Ragweed, common	*Ambrosia artemisiifolia*	45, 52, 83, 85, 86, 96, 99
Ragweed, bur	*Franseria tomentosa* and *discolor*	35, 74, 108
Range, weed control on		5
Rapeseed, Argentine	*Brassica* sp.	50, 77, 81, 91, 96
Raspberries	*Rubus* sp.	15
Registration list		115 - 122
Regulatory work		25, 27 - 33
Research Committee, members		63
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Resolutions		59
Rice		47
Right-of-way weed control		37, 40
Rose, multiflora	*Rosa multiflora*	43, 105
Roses, wild	*Rosa* sp.	35, 104
Ryegrass	*Lolium* sp.	50, 55
S		
Safety in herbicide use		13
Sagebrush, big	*Artemisia tridentata*	21
Sassafras	*Sassafras albidum*	35
Sedges	*Carex* sp.	41
Seeds, weed, germination		20
Serviceberry, Saskatoon	*Amelanchier alnifolia*	104
Sida, prickly	*Sida spinosa*	95
Shepherdspurse	*Capsella bursa-pastoris*	81
Site preparation, chemical		42
Small grains, weed control		110
Smartweed, ladysthumb	*Polygonum persicaria*	80, 85, 87, 92, 97, 98, 109
Smartweed, swamp	*Polygonum coccineum*	74, 108
Smartweeds	*Polygonum* sp.	41, 52, 83, 84, 86, 96
Smilax	*Smilax* sp.	35
Snowberry	*Symphoricarpos occidentalis*	104
Sorghum	*Sorgum* sp.	43, 47, 50, 51, 55, 74, 83, 84, 109
Sowthistle, perennial	*Sonchus arvensis*	9, 20, 68, 69, 97, 107
Soybean	*Glycine max*	47, 50, 53, 55, 84, 85, 86, 110
Spruce	*Picea* sp.	35, 43, 104
Spurge, leafy	*Euphorbia esula*	9, 16, 35, 69, 70, 108
Squash	*Cucurbita* sp.	14
Starthistle, yellow	*Centaurea solstitialis*	35
Sticktight, European	*Lappula echinata*	81
Stinkweed, see field pennycress		
Strawberry	*Fragaria* sp.	44, 45
Stubble cover, effect on germination of wild oats		15
Sumac	*Rhus glabra*	35
Summary, new research findings		106
Summerfallow, chemical		35
Sunflower	*Helianthus* sp.	47, 50, 75, 95, 110
Susceptibility to herbicides, table		113, 114
Sweetclover	*Melilotus sp.*	92, 93
T		
Tanweed, see swamp smartweed		
Thistle, Canada	*Cirsium arvense*	9, 20, 23, 35, 68, 97, 107
Thistle, Russian	*Salsola kali*	35, 80, 81, 91
Tillage (for weed control), see cultivation		
Toadflax, yellow	*Linaria vulgaris*	9, 16, 22, 70, 71, 108
Tobacco	*Nicotiana tabacum*	95, 110
Tomato	*Lycopersicum esculentum*	14, 46, 50, 55
Toxic compounds in weeds		16
Toxicity of herbicides		12
Toxicity, residual, from herbicides		103
Trefoil, birdsfoot	*Lotus corniculatus*	92, 94
Trumpetvine	*Campsis radicans*	35
Tulip	*Tulipa* sp.	14
Turf		20, 48, 101
V		
Velvetleaf	*Abutilon theophrasti*	85, 96
W		
Walnut, black	*Juglans nigra*	39
Wheat	*Triticum vulgare*	15, 36, 50, 51, 65, 75, 76, 77, 78, 79, 80, 87, 88, 89, 90, 91, 103
Wheatgrass, crested	*Agropyron cristatum*	81, 104
Whitetop	*Fluminea festucacea*	41
Willow, sandbar	*Salix* interior	41
Wild life, food patches, chemical preparation		42
Windbreaks, chemical weed control		43
Witchgrass	*Panicum capillare*	101
Woody plant control		5, 111

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Herbicide List and Index

The nomenclature of this list is based so far as possible on the Report of the Terminology Committee of the Weed Society of America made at Denver, Colorado, February 23, 1960. This report was not made in time to edit the text to conform with it, but this index indicates the changes. Most conspicuous is that the triazine and some other previous trademarks have become common names, and so are not capitalized. These changed or new common names are starred in the index below. The "Summary of New Research Findings" has not been indexed for herbicides.

Names which begin with numerals are indexed as if spelled out; capitalization is indicated.

A Page

*acrolein—acrylaldehyde 20
alpha-chloro-*N*,*N*-dimethylacetamide 83
*AMA—octyldodecyl ammonium methyl arsonate 102
*amiben—3-amino-2,5-dichlorobenzoic acid 14, 44, 45, 46, 47, 49, 80, 82, 84, 85, 86, 87, 92, 97, 98, 100, 101, 102
Amino triazole—amitrole
*amitrole—3-amino-1,2,4-triazole 9, 34, 35, 37, 41, 42, 44, 48, 52, 68, 69, 70, 71, 73, 79, 80, 83, 84, 86, 97, 104, 105
amitrole-T—3-amino-1,2,4-triazole plus ammonium thiocyanate 41, 71, 73, 83, 84, 97, 104
*Ammate X—trademark, formulation of ammonium sulfamate
Amoben—1958 and early 1959 trademark for amiben, 3-amino-2,5-dichlorobenzoic acid
ammonium sulfamate—AMS
AMS—ammonium sulfamate 24, 35, 104
Aqualin—trademark for product containing 85% acrolein
arsenic—see sodium arsenite, sodium arsenate, AMA, DMA
ATA—old designation for amitrole
Atlacide—trademark for a mixture containing 58% sodium chlorate
*atratone—2-methoxy-4-ethylamino-6-isopropylamino-*s*-triazine 86
*atrazine—2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine 44, 52, 66, 78, 79, 80, 82, 83, 84, 86, 87, 97, 103, 105
Avadex—trademark for 2,3-dichloroallyl diisopropylthiolcarbamate, cis and trans mixture

B

*barban—4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate 14, 15, 35, 51, 74, 75, 76, 77, 78, 79, 80, 88, 89, 90, 91, 92, 100, 103
Baron—trademark for erbon
BDM—borate-2,4-D mixture 9, 24, 34, 68, 69, 70, 71, 73, 74
B-562—code for 2-isopropylamino-1,4-naphthoquinone
BMM—borate-monuron mixture 41, 70, 73, 105
Borascu—trademark for sodium borate ore, 34% boron trioxide
Borascu, Concentrated—trademark for anhydrous sodium borate ore, 61.5% boron trioxide
borax—crystallized sodium borate, $Na_2B_4O_7.10H_2O$

C

cacodylic acid 34, 67
calcium arsenate 20, 48, 101, 102
Carbyne—trademark for barban
CBM—chlorate-borate mixture 9, 22, 24, 73, 105
CBMM—chlorate-borate-monuron mixture 24, 105
CDAA—2-chloro-*N*,*N*-diallylacetamide 14, 40, 45, 46, 51, 52, 53, 54, 79, 82, 83, 84, 85, 86, 87, 95, 96, 97, 99, 100, 101
CDEC—2-chloroallyl diethyldithiocarbamate 46, 99, 100, 101
CDT—old designation for chlorazine
C-56—code for hexachlorocyclopentadiene
chlorate—see sodium chlorate
Chlorax—trademark for a CBM
*chlorazine—2-chloro-4,6-bis(diethylamino)-*s*-triazine 87
chlordane—1,2,4,5,6,7,8,8-octachloro-4,7-methano-3a,4,7,7a-tetradhydroindane 48, 101, 102
Chlorea—trademark for a CBMM
CIPC—isopropyl *N*-(3-chlorophenyl)carbamate 15, 45, 46, 47, 84, 85, 86, 89, 95, 96, 97, 99, 100
citric acid 81
CMU—old code for monuron
Concentrated BORASCU—trademark for granular anhydrous sodium borate, 61.5% boron trioxide
copper sulfate crystals 20
copper sulfate, tribasic 20
CP1815—code for a mixture of chlorinated benzoic and cresoxyacetic acids 9, 34, 69, 71, 73, 80, 81, 87
CP5996—code for 2,6-dichlorobenzonitrile
CP6936—code for 2-chloro-*N*-ethyl-*N*-phenylacetamide
CP10543—code for 3-(3,4-dichlorophenyl)-1-isopropyl-1-(2-propynyl)urea
CP15336—code for 2,3-dichloroallyl diisopropylthiolcarbamate

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Herbicide List and Index (Continued)

D

Page

dalapon—2,2-dichloropropionic acid 9, 14, 22, 34, 37, 42, 44, 46, 65, 66, 68, 70, 71, 79, 80, 81, 83, 84, 93, 94, 97, 98, 101, 104
DAC893—code for dimethyl 2,3,5,6-tetrachloroterephthalate
DB Granular—trademark for a BDM
DCU—dichloral urea 97
Diax—trade name, mixture 2,4-D and citric acid
Dicryl—trademark for *N*-(3,4-dichlorophenyl)-methacrylamide
dimethyl 2,3,5,6-tetrachloroterephthalate (DAC 893) 14, 46, 48, 83, 84, 97, 98, 101, 102
*diquat—1,1′-ethylene-2,2′-dipyridylium dibromide 9, 80
Dinoben—trademark for 2,5-dichloro-3-nitrobenzoic acid
diphenylacetonitrile (L-13489) 46, 86, 102
diuron—3-(3,4-dichlorophenyl)-1,1-dimethylurea 15, 37, 51, 80, 83, 87, 97, 99, 101, 105
*DMA—disodium monomethylarsonate 102
DMTT—3,5-dimethyltetrahydro-1,3-5,2H-thiadiazine-2-thione (Mylone) 95
DNBP—4,6-dinitro-*o*-*sec*-butylphenol 15, 46, 51, 52, 80, 83, 84, 85, 86, 97, 98, 100
DSMA—DMA
du Pont 685—code for 1-chloro-*N*-(3,4-dichlorophenyl)-*N*,*N*-dimethylformamidine
Dybar—trademark for pelleted 25% fenuron

E

endothal—3,6-endoxohexahydrophthalic acid 77, 97, 100
Eptam—trademark for EPTC
EPTC—ethyl-*N*,*N*-di-*n*-propylthiolcarbamate 37, 44, 45, 47, 51, 53, 65, 67, 75, 76, 77, 79, 80, 82, 83, 85, 86, 88, 89, 90, 93, 94, 95, 96, 97, 100, 101
erbon—2-(2,4,5-trichlorophenoxy)ethyl 2,2-dichloropropionate 24, 34, 40, 41, 71, 105
ethyl ethyl-*n*-butylthiolcarbamate 86
ethyl xanthogen disulfide—EXD
EXD—ethyl xanthogen disulfide 99

F

Falone—trademark for tris(2,4-dichlorophenoxyethyl) phosphite
FB-2—code for diquat
*fenac—2,3,6-trichlorophenylacetic acid 9, 15, 34, 36, 65, 67, 76, 80, 82, 83, 84, 88, 101, 103, 104
fenuron—3-phenyl-1,1-dimethylurea 38, 67, 104, 105
*fenuron.TCA—3-phenyl-1,1-dimethylurea trichloroacetate (Urab) 39, 96, 97
4-chloro-2-butynyl *N*-(3-chlorophenyl)carbamate—barban
4-(MCPB)—4-(2-methyl-4-chlorophenoxy)butyric acid 9, 11, 23, 68, 69, 81, 87, 92
4-(2,4-DB)—4-(2,4-dichlorophenoxy)butyric acid 11, 23, 68, 69, 81, 87, 92, 93, 94

G

G-25804—code for chlorazine; (earlier, Geigy 444E and CDT)
G-27682—code for simazine
G-27901—code for trietazine
G-30026—code for 2-chloro-4-isopropylamino-6-methylamino-*s*-triazine
G-30027—code for atrazine
G-30028—code for propazine
G-30031—code for ipazine
G-30044—code for simetone
G-31435—code for prometone

H

HCA—hexachloroacetone 40, 66
hexachloropentadiene (C-56) 66
Hyamine 2389—code for alkyl tolyl methyl trimethyl ammonium chlorides 20

I

*ipazine—2-chloro-4-diethylamino-6-isopropylamino-*s*-triazine 44, 87, 97, 100, 101
IPC—isopropyl-*N*-phenylcarbamate 14, 36, 37, 77, 96

K

Kalzate—trademark for potassium salt of MCPA
Karmex DW—trademark for diuron
Karmex W—trademark for monuron
Karsil—trademark for *N*-(3,4-dichlorophenyl)-2-methylpentanamide
kerosene 40, 66
Kloben—trademark, 50% neburon formulation
KOCN—potassium cyanate 102

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Herbicide List and Index (Continued)

L Page

lead arsenate 102
L-09726—(*p*-chlorophenyl)phenylacetonitrile
L-13489—diphenylacetonitrile

M

MCP—MCPA
MCPA—2-methyl-4-chlorophenoxyacetic acid 9, 11, 23, 34, 69, 70, 73, 80, 81, 89, 90, 91, 92, 98, 102
MCPB—4-(MCPB)
Methoxy Propazine—trademark for prometone
MH—maleic hydrazide 74, 101
MCPP—2-(MCPP)
M1329—code for *O*-2,4-dichlorophenyl *O*-methyl isopropyl-phosphoramidothioate
monuron—3(*p*-chlorophenyl)-1,1-dimethylurea 9, 15, 17, 37, 40, 67, 70, 71, 73, 80, 97, 99, 100, 105
*monuron.TCA—3-(*p*-chlorophenyl)-1,1-dimethylurea trichloroacetate (Urox) 39, 71
Mylone—trademark for DMTT

N

n-butyl 2-propoxybenzoate (U-9613) 102
neburon—1-*n*-butyl-3-(3,4-dichlorophenyl)-1-methylurea 45, 46, 69, 80, 81, 82, 83, 84, 92, 95, 97, 101, 102
N-4512—code for *N*-(3-chloro-4-methylphenyl)-2-methylpentanamide
N-4556—code for *N*-(3,4-dichlorophenyl)methacrylamide
N-4562—code for *N*-(3,4-dichlorophenyl)-2-methylpentanamide
N-5996—code for 2,6-dichlorobenzonitrile
Novon—trademark for erbon
NPA—*N*-1-naphthylphthlamic acid 51, 84, 85, 86, 95
N-(3-chloro-4-methylphenyl)-2-methylpentanamide (Solan) (N-4512) 14, 47, 98, 100
N-(3,4-dichlorophenyl)-methacrylamide (Dicryl) (N-4556) 47, 97, 98, 100
N-(3,4-dichlorophenyl)-2-methylpentanamide (Karsil) (N-4562) 14, 47, 97, 98, 100, 101

O

1-chloro-*N*-(3,4-dichlorophenyl)-*N*,*N*-dimethylformamidine (duPont 685) 83
1,1'-ethylene-2,2'-dipyridilium dibromide—diquat
O-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate 77, 79, 82, 83, 85, 96, 97, 98, 99, 101, 102, 103

P

PAX—trademark for a crabgrass killer based on lead arsenate plus chlordane
PBA—mixtures of chlorinated benzoic acids ranging from dichloro- to pentachloro 35, 73, 74, 95, 105
(*p*-chlorophenyl)phenylacetonitrile (L-09726) 42, 86, 102
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PMA—phenylmercuric acetate 102
Polybor-chlorate—trademark for a CBM
polychlorobenzoic acids—PBA
P,*P*-dibutyl-*N*,*N*-diisopropylphosphinic amide
*prometone—2-methoxy-4,6-bis(isopropylamino)-*s*-triazine 85, 86, 87
*propazine—2-chloro-4,6-bis(isopropylamino)-*s*-triazine 44, 84, 87, 97, 98, 100
propyl di-*n*-propylthiolcarbamate 86
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R

Randox—trademark for CDAA
Randox T—trademark for CDAA plus trichlorobenzyl chloride

S

S-847—code for barban, 1958
sesone—sodium 2,4-dichlorophenoxyethyl sulphate 44, 51, 101
silvex—2-(2,4,5-trichlorophenoxy)propionic acid 46, 81, 82, 84, 104, 105
*simazine—2-chloro-4,6-bis(ethylamino)-*s*-triazine (simazin) 9, 15, 37, 40, 42, 44, 46, 51, 52, 53, 78, 79, 80, 82, 83, 84, 87, 95, 99, 100, 103, 105
*simetone—2-methoxy-4,6-bis(ethylamino)-*s*-triazine 85
SMDC—sodium *N*-methyldithiocarbamate (Vapam) 105
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Solan—trademark for *N*-(3-chloro-4-methylphenyl)-2-methylpentanamide
Stoddard Solvent—petroleum product containing 15 to 18 percent of aromatic compounds 47, 97, 100

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Telvar DW—trademark for diuron
Telvar W—trademark for monuron
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3-(3,4-dichlorophenyl)-1-isopropyl-1-(2-propynyl) urea (CP-10543) 98, 99
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2-chloro-4-ethylamino-6-diethylamino-*s*-triazine—trietazine
2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine—atrazine
2-chloro-4-isopropylamino-6-methylamino-*s*-triazine 84, 87
2-chloro-4,6-bis(diethylamino)-*s*-triazine—chlorazine
2-chloro-4,6-bis(ethylamino)-*s*-triazine—simazine
2-chloro-4,6-bis(isopropylamino)-*s*-triazine—propazine
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2-(2,4,5-TP)—silvex

U

Urab—trademark for fenuron.TCA
Ureabor—trademark for a BMM
Urox—trademark for monuron.TCA

V

Vapam—trademark for SMDC
Velsicol B—code for 2-methoxy-3,6-dichlorobenzoic acid
Velsicol C—code for 2-methoxy-3,5,6-trichlorobenzoic acid

Z

Zytron—trademark for *O*-2,4-dichlorophenyl *O*-methyl isopropylphosphoramidothioate
(Zytron in 1958 was used as a trademark for a silvex-dalapon mixture.)

XUM

XUM